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KOREAN INTERVIEWS.

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DURING my residence in Japan I sought many interviews with Korean students, *attachés* of the Korean legation, and others, and in journalistic fashion asked them many questions concerning their country, people, habits, manners, customs, etc. At that time I found no Korean who understood English, but the younger men were studying Japanese, and so through them, by the aid of a Japanese interpreter, I managed to ask many questions of the older men. Since my return a number of opportunities have occurred—meeting Koreans who spoke English, and for several months I had a Korean as house companion. The information thus gained was not originally intended for publication, but for comparison with similar material of a cognate but far more advanced people, the Japanese.*

I may say here, though not as an excuse for any errors which may doubtless occur, that my questions could not have been more carefully asked, or the answers more promptly recorded, had I been on Korean soil. It is also proper to state that in every case the information was derived from Koreans of official position, and therefore the statements, so far as their own class is concerned, ought to be reliable.

* It is an extraordinary fact that in the late war with China the Japanese, single-handed, overawed the Koreans, a hostile nation of at least eight million people, drove every Chinese soldier out of the country, and, had it not been for the interference of three powerful European nations, would have held the Regent's Sword, and would have supported the young Korean party in its patriotic efforts to regenerate that poor country. That the Koreans could not make the faintest stand against the Japanese, though aided by Chinese armies, leads one to wonder what manner of people are the Koreans, and this is my reason for publishing the following memoranda, disjointed and fragmentary as they are.

FAMILY RELATIONS.—The relations between the father and son are very strict, as between the king and the subject. If the son enters the room where the father is sitting, he must meekly stand with hands together until invited by his father to be seated; in sitting, he must lean forward in a humble attitude; he can not rise again without permission. He sweeps his father's room, makes his bed, and rises early to perform these menial services; he often gets up at midnight in solicitude for his parent's comfort. Filial love prompts these attentions, for fear the servants may grumble and complain and thus bring disquiet to the parent. In summer the son fans his father and attends minutely to every want; this same attention and respect are shown to his father's friends. Seasonal changes of clothing are not made until the parent's consent is given. It is considered exceedingly improper to cough, sneeze, eructate, or spit before old men. Boyhood continues until the fifteenth year, or until marriage; up to this time the hair hangs behind in a long queue; when manhood is assumed the hair is tied in a knot on top of the head. All the possessions of the children, as well as their earnings, belong to the father, and no matter how much the son may have the father can claim it all. If, however, the son lives in a separate house, he has the use of his earnings as well as his wife's dower; but if the father has no money, he may sell his son's house over his head and take all. Old men will not allow their sons to drink intoxicating liquors. From all that I could learn, the son is in abject enslavement to his father. After the death of the father the property goes to the oldest son. Brothers are very devoted to one another, and aid in supporting the less fortunate among them.

The daughters have a much easier time; they do nothing but eat and dress; they jest with their father and brothers, scold them, and act with great familiarity; indeed, all my inquiries about their behavior brought out the fact that they act like spoiled children.

Virtue is rarely lost among the more favored classes. Male and female servants do not sit down together or work in the same apartment. The wife is absolute mistress of the female servants. The apartments of the female servants are under a separate roof, and male servants never enter these apartments, though their duty is to clean the yard and garden belonging to the female servants. Servants are inherited by successors in the family; they are bought and sold. Loyal servants work and support their masters when they become poor. Masters can and do free their servants.

EDUCATION.—The higher classes employ private teachers. Children at the age of five or six begin the study of Chinese characters; they are provided with books for composition. Five

rules of conduct are drilled into them; these are: To obey the father, respect the elder brother, be loyal to the king, be respectful to the wife, and be true to friends. These rules are strictly Confucian. After these rules are firmly fixed in the minds of the pupils they are taught to compose letters; next comes the study of history; after these studies Confucius and the Chinese classics are taken up, and finally the art of poetical composition. These studies go on through life. A gentleman will study classics in winter, composition of poetry in spring, and in summer study those subjects which will fit him for official duties. The king appoints judges to examine candidates for office; the number appointed may be three, seven, or twelve. The student for examination is locked up in a room for three days without books. The subjects usually selected for examination are from ancient poetry and classics, as follows: 1. Long-word poetry of seven words. 2. Short-word poetry of six words. 3. Problems in classics. 4. Clearing up doubts in classics. 5. Criticising famous men of olden times. 6. Considering what system of morality is best to correct or modify bad customs. 7. Suggesting what kind of military organization is best to defend and control the country. In these various examinations it is claimed that poetry reveals one's nature, that problems in classics show one's knowledge, that clearing up doubts in classics demonstrate one's powers of decision, that criticising famous men indicates one's knowledge of persons, that judging of the best system of morality and deciding as to the best kind of military organization displays one's mental attributes.*

In olden times Korea had public schools; for centuries it has had none. Private schools are kept in private houses; no special school building is known in the land. In many Confucian temples free classes are supported by the priests, but only Confucian doctrines are taught. Buddhists have no schools, but have stated times of teaching and expounding.

POSITION OF WOMEN.—The condition of women in Korea is unhappy and degraded to the last degree. Among the more favored classes the women are kept as prisoners within the house; in rare instances they may visit relatives. This seclusion begins after a girl reaches the age of ten or twelve. Four or five hundred years ago they had greater freedom. The women often refer to these times, and the intelligent classes express sympathy and pity for their present unfortunate condition. The seclusion of the women from the men is so strict that it is customary in the cities

* The swindling and thieving character of Korean officials, their torturing and murdering subjects without trial, and the degradation and helplessness of Korea to-day, stand in curious contrast to this ennobling list of studies and examinations, and indicate a depth of hollow pretense and hypocrisy which is simply appalling.

for the thatcher, before climbing to the roof, to shout in loud tones, "The thatcher is coming! the thatcher is coming!" so that the women in neighboring compounds may have a chance to run to cover.

Women are confined to domestic labor. Among the lower classes the husband has a right to beat his wife. There is no law for women. If she commits a crime, such as a personal assault or theft, she is not punished, but her husband is. A woman can pass in front of the king's procession, and the king must wait. The women are considered greater than men in trivial things.

CUSTOMS.—The chopstick is evidently not so commonly used in Korea as in Japan or China. A spoon is used for soup and all other forms of liquid food; even rice is eaten with a spoon. Dry food, however, is eaten with the chopstick. Guests of high rank sit midway between the two ends of the table. If two guests are present, they sit side by side. When at table the Koreans remain silent and eat very slowly. In passing food both hands must be used in holding the dish, as in Japan. In summer the meals are usually at seven, one, and eight o'clock. Dinner is at midday, though there is very little difference in the character of the meals. *Saké* is drunk at every meal.

The relation between master and servant is supposed to be the same as that between father and child. The servants help the master through the yard to his house and up the steps, and this attention is given whether the master stands in need of assistance or not. At dinner a servant ties a big napkin about the master's neck.

The Koreans have no music at weddings or funerals. (Contrary to this information, Carles records loud chanting at funerals.) On birthday festivities and times of feasting music is heard. They have battle songs and love songs.

The Koreans never tattoo or wear earrings, though in the western part of the peninsula prostitutes are sometimes seen with earrings. Women use paint for facial decoration. Men and women wear finger rings, but this custom is not very common with men.

An extraordinary feature is seen in the dress of women of the lowest classes, in the fact that the breasts are fully exposed. An abbreviated jacket drops from the neck to the upper part of the breast, while the waist of the skirt portion comes up just under the breast. The exposure of this part of the body seems all the more singular when it is considered that Koreans never go barefooted; even coolies working in the city do not go barearmed or barelegged. Women rarely wear a comb in the hair. Men and women do up their own hair.

Among the middle and higher classes it is considered improper to speak of money, and for this reason mathematics is not taught.

All openings in the house must be square. An arched doorway or window is not allowed except in the emperor's palace. There is a prohibitory law against decorating in any way the outside of a house, nor can the people build a house of over one story. Streets are named after trees, famous men, historical events which have happened on the ground, and attributes. Thus there is a Happy Street, Blessing Street, Virtuous Street, etc.

For centuries the fishermen of Korea have been accustomed to pour oil on the water to make the sea calm. The Japanese also follow the same practice.

MARRIAGE.—Koreans never marry cousins or any one descended from the same ancestors, or even any one of the same name. One of the most famous of Korean kings, Seijong Daiwang, four hundred years ago, said that intermarriages would cause the race to become extinct. It was this same king who invented movable type made of iron. Marriages are arranged by the parents. The bridegroom does not see the bride until the wedding. The groom goes to the bride's house and escorts her to his own house; after reaching the house they bow to one another standing. The bride then bows to the groom's father and mother and other relatives. She then offers wine and fruit to the groom's parents, and this represents a form of tribute. The relatives of both parties then have a great feast. When the groom goes to the bride's house he carries a paper from his father to the father of the bride, upon which is written, "I have a son, you have a daughter." He also carries with him two pieces of silk—one red, the other blue—each piece sufficient for a suit or dress. The red silk is wrapped in blue paper and tied with a red cord, while the blue silk is wrapped in a red paper and tied with a blue cord. The cords are tied in a peculiar knot called the "same-mind knot." Blue signifies the male principle, and red the female principle. This silk constitutes the wedding present, and is known as the "first cloth of ceremony silk," meaning the first present of her future husband. Dresses are afterward made of these pieces. When the wife dies the letter from her husband's father, above mentioned, is buried with her.

The first son derives his name from both parents; thus, if the father's name is Kum Pak and the mother's name is Chul Hei, then the boy's name will be Kum Hei. A boy may marry as young as fifteen years—that is, the ceremony may be performed then—but he does not live with his wife until he is eighteen. They may see each other, however.

Adultery is punished by fining both parties. For rape the offender is heavily fined and exiled for three years. Prostitution is recognized by the Government. Adulterers are often forced to be cooks in prisons and otherwise severely treated. Concubines

are allowed by law, but the practice is considered bad, as it is liable to break up the family relations, and the finger of scorn is often pointed at the man. Rich men have concubines in secret.

Widows of higher classes never marry, though four hundred years ago they had the privilege of marrying again. This prohibition does not extend to the lower classes. Divorces are not permitted, but separation takes place in case of adultery; the man, however, can not marry again. Marriage with a slave girl is considered a great disgrace, and the friends of one who commits such an offense desert him. Children born of such a union, however, are not regarded with reproach.

MANNERS, HABITS, ETC.—The Chinese practice of medicine is in full force; the lower classes rarely employ a doctor, but ask the advice of gypsies. The people believe that all sickness is caused by evil spirits. Blind people find employment as devil expellers.

The liquors drunk are distilled and fermented from rice, corresponding to the Japanese *sochiu* and *saké*. An impure wine is made from oats; there is also a malt wine resembling ale. Liquors, cordials, or wines are made from bamboo, honey, peach, and pear mixed with *saké*. A wine is made out of the new twigs of the pine; there is also a wine called the *hundred-flower wine*.

A Korean gentleman of high rank assured me that it was considered impolite for children to say "Thank you" to their parents. Parents never thank their children, and at table the expression is not heard. The children eat at a separate table from their parents. It is considered impolite to smoke in the presence of another without asking permission and offering tobacco.

As an illustration of the rigid lines of propriety, a young man in the family is chided if he undertakes to make any addition or improvement to the house; he is told that such work is for the carpenter or cabinet-maker. He must attend to his books; he can not even invent or suggest any device.

Five hundred years ago the Koreans had paper money; this was very thick, and varied in size according to the denomination. Until within a hundred years they had gold and silver coins, lenticular in shape, like the checkers used in the game of "go." The coinage was abandoned by the Government on account of the extensive counterfeiting. The nobles now use these coins as checkers for "go."

The iron horseshoe was invented by a Korean general who fought against the Japanese invaders in 1596; before that time straw horseshoes were used, as in Japan.

It is customary to build large bonfires near pine forests, to attract and destroy moths, thus preventing destruction of forests.

RELIGION AND MORALS.—The general Government supports Confucian temples. In one temple there are over two hundred Confucian philosophers. Every county has its temple, with twenty or thirty Confucians. The Government stands in fear of these men, for they vigorously protest if rulers err in any way, and more particularly if their allowance is abbreviated. Confucius forbade the study of curious things as disturbing to the mind, and this ridiculous idea has grown into a superstition, and thus a man is prevented from preserving any relic dug from the ground for fear of a ghost following it. Previous to the fourteenth century the country was strongly Buddhist; since that time Confucian doctrines have spread from China, and within four hundred years Buddhists have been expelled from all cities and towns, and their temples have been destroyed. The priests can not even live in the villages, but must live in the mountains away from the villages. A certain Buddhist monument, thirty feet in height, was so beautiful that even Korean bigotry would not destroy it; it was cut halfway down, and the upper half was placed on the ground near the monument's base.

Pupils of Confucius are taught that if struck on one cheek they must turn the other, and if spat upon they must let it dry, for wiping it away would signify anger. Friendship is believed to be more faithful among Koreans, and the people are supposed to be more truthful than the Chinese or Japanese.

BURIAL.—The body when buried must be clothed in a shroud made of native cloth; this differs but slightly from the usual dress. A burial service is held, but no religious ceremony. Poor people hire a hearse, but a rich man will have a special one constructed. If the deceased cared for any special objects, these are buried with him—books, for example. The grave is dug to the depth of six feet. This depth is fixed for all. Books are published describing the forms of burial. The expenses of a funeral, with the construction of a tomb, a new hearse, etc., are often very great. The body may be kept in the house from three days to three months. Confucian doctrines enjoin a mourning period of three years, during which time no work is done. The king mourns seven days. A prominent feature of the mourner is a hat of large size, which comes down to the shoulders, thus concealing the face. The mourning color is yellow; it was formerly white. The clothing is always made of flax. No one ever accosts or interrupts a mourner on the street, and Jesuit priests often use the mourners' habiliments as a disguise.

OPERATIVE.—Among the various trades and occupations are those coming under the definition of silver- and goldsmiths, iron and bronze workers, builders and architects, wrights of various kinds, masons, decorators, artificers, weavers, saddlers, butchers,

curriers, salt makers, a few seal engravers, plowmen, cattle and swine drovers, special thatchers and tilers, no barbers, but hairdressers, dyers, tanners, carpenters and cabinetmakers, and these latter go by the name of large and small carpenters. Craftsmen are not allowed to sell raw material; the lumber dealer, for example, would prevent a carpenter from selling even a board. There are also stone polishers, paper pasters, and tailors who make clothing by quantity. As in this country, such clothing is not considered as good as custom-made clothing. Women make their own clothing. Boys are not commonly employed, but are sometimes seen on the streets as peddlers. In Japan, on the contrary, boys are everywhere employed, and in all occupations, thus adding to the industrial strength of the nation. Men make shoes, though this is considered a mean occupation. Sandals are made by monks. As with us, there is a localization of industries and trades. A system of apprenticeship exists. In the first year's service the apprentice is fed, in the second year he receives half pay, and in the third year full wages are paid him; in the fourth year, if skillful, he becomes a partner in the work, or goes off by himself, the master helping him. The Government builds long markets in which are shops for special merchandise, such as silk, cotton, shoes, paper, etc. These are hired by merchants on perpetual lease, and the merchant who thus rents a shop receives all the trade in his specialty. Thus every one dealing in cotton must come to the cotton shop. A shop thirty or forty feet long will sell for five thousand dollars. Traders are accustomed to borrow capital from the nobles, upon which they pay interest. There are a great many guilds, which are called Brotherhoods in Trading. Partnerships are common. In the guilds, if one meets with a loss or failure all the others help make up the loss; in partnerships this is not so.

Public work is done by the co-operation of villages. In Séoul public work is done by the general Government, the city, however, collecting taxes for the work. If the people volunteer to do the work, no taxes are imposed. If the municipality does the work, then continuous taxes are collected; if the Government does it, the city is taxed for it. In the country, five days' work on public improvements is considered an equivalent for the tax.

In farm work no distinction is recognized between the sexes. Female domestics are employed in spinning, weaving, sewing, and universally in cooking; women even of high rank may cook with propriety; indeed, such service is considered quite legitimate for women of all ranks. Men never become cooks. In certain districts women make hats and straw mats. In the western part of the country silk is made, in the northern part linen, while in the southern part cotton is made. This kind of work is all done by women.

REGULATIVE.—Co-operations are not hereditary, excepting those connected with the soil, such as mining, brick, tile and pottery kilns, etc. Farm labor is done by freemen and serfs. Serfs are called tributary slaves. The Government pays for its labor. During the times of great depression the Government orders certain work to be done as a relief to the people. Three kinds of public work are done—namely, by the Government, by the city, and by the people. For example, the people living near a river embankment may plant trees upon it (usually the willow, pine, or elm). Serfs in government employ work eight hours a day. In the Department of the Interior, and other departments, the king appoints a secretary or head officer, who in turn employs the subordinates. As an illustration of the shameful waste of time, it is customary for a force of employees to work by installments: thus, if thirty serfs are employed, ten of these work for three days only, then another lot of ten continues the work for three days, and finally the third set of ten takes up the work for the same time; thus, each set of ten have a week's vacation following three days' work. What wonder that the people are among the poorest on earth! There are two kinds of serfs, a higher and a lower kind. The higher serfs take their vacation in precisely the same way. The chiefs of departments have under their control not only various clerks, but also serfs who accompany the chiefs to their houses, and the chiefs may employ them on their own private work. There are no lawyers. Judges there are, and these are appointed by the king.

The commercial ways are very low. In some respects the methods are like those of nomadic tribes. Peddlers are called burden merchants, and travel through the country; if they have means they will buy their food; if not, they beg. They have no house or home, but with their families are traveling all the time. These people have very severe laws among themselves. Adultery is punished with death. When this crime is detected a letter is circulated among them. Hundreds assemble, and each one strikes the adulteress with a stick or club. They are very kind and polite among themselves. In many respects they resemble our gypsies, but are true Koreans, and are considered the lowest class. There are the other kinds of merchants who have no shops, but assemble in small towns on every fifth day to buy and sell. This is derived from an old Chinese custom. The higher classes of merchants have shops. Pawnbrokers abound, and auctions are common.

FESTIVALS.—The last day of the old year and the first week of the new year are given up to festivities. The fifteenth day of the first month is called the New Moon holiday. A particular kind of food is made at this time, consisting of dates, chestnuts, honey,

and cake rice (a peculiar kind of rice) boiled together. This food is called medicine food, and is supposed to be prophylactic and also to strengthen the brain. In the country, torches are lighted to welcome the moon, and people assemble in great numbers to catch the first glimpse of the moon, as it insures happiness. This day is also observed as All-Fools' Day. A favorite trick is to attach a flower secretly to some one's clothing.

In the second month, usually on the sixteenth, Butterfly holiday occurs. The third day of the third month is observed as the Flower holiday. On this day young men make cake of flowers mixed with wheat and rice, and this is fried; they also cook fish, and other articles of food.

The eighth day of the fourth month is called by the Buddhists the Washing-day of Buddha. Households have a lantern for each person, and these are supplied with oil lamps instead of candles, as candles are made of ox fat or honeycomb, and Buddha forbids the killing of animals. Oil for lamps is always a vegetable oil. The lower classes attend church on this day and sacrifice to Buddha. A cake is made of black beans, and this was formerly decorated with flowers; now this is rarely done, though artificial flowers are sometimes used for this purpose. At this time forms of animals are made of meal or lime and sold to the children.

The fifth day of the fifth month is called Swinging Day, and is derived from China. Swings are suspended from trees and frames, and everybody indulges in the sport. Boys put on their new clothes at this time. The root of the flag is cut with a sloping edge which is colored red, and this is worn in the hair to ward off calamities. (The Japanese have a holiday at this time, but have no idea of its derivation.)

The sixteenth day of the sixth month is observed as Hair-washing Day. Everybody observes the day except the laborer. At this time wheat cake and macaroni are eaten.

The seventh day of the seventh month is observed as a general holiday, and cake and macaroni are eaten. The holiday is based on the following story: Two stars in heaven were married; one was the daughter of God. Before marriage she was very industrious, but after marriage she became negligent and idle, and God, becoming angry, banished her to the eastern part of the Milky Way, while the male star was sent to the western part of the Heavenly River, as the Japanese call it. The woman had to weave, and the man had to attend cows. The female star is called the Weaver, while the male star is called the Patroller. They are allowed to meet once a year on this day. If it rains during the evening of that day it is interpreted as being caused by the tears of separation.

The fifteenth day of the eighth month is the Harvest holiday.

It forms a great festival for the farmers, and is much like a New England Thanksgiving Day. Gentlemen go to the country to see the festival, have food and wine, and generally get hilarious.

The ninth day of the ninth month is observed because the maple trees turn red and yellow flowers are in bloom. Poetry is written about the day and its beauties.

The tenth day of the tenth month is observed by every one making cake in the evening. Each one makes a number of cakes and presents them to all his friends. Friendship is supposed to be bound and strengthened by these gifts. Gentlemen engage in this pastime, and it is also a great day for the farmers.

On the eleventh month, at the winter solstice, a drink is made of red beans, and on this day sacrifice to ancestors is made.

On the twelfth day of the twelfth month people go hunting. Young men also call on the old men, who offer food and give good advice, and will say, "One year older, one year more." On this day the young man can sit down in the old man's presence and will listen respectfully to his advice.

Besides these stated festival days parties are often given, and if ten are invited, for example, provision must be made for three hundred, as each invited guest is accompanied by many servants, high and low. A large table is provided for each guest, and this is heaped with food and fruit, of which little is eaten, as most of it is given to the low servants, special tables being provided for the high servants. An ordinary party of this kind may often cost a thousand dollars.

A certain kind of picnic is called a "one-dish party." This is for men only, and each man brings to such a picnic a dish of some one kind of food sufficient in quantity for all.

GAMES.—The Koreans have dice, and cards of two kinds, with which several games are played, one being a gambling game, which is forbidden by law. They have chess, and "go," a peculiar game with four sticks, and also many puzzles. Children play ball by patting and bouncing it on the ground, have whipping tops, and fly kites. A portion of the kite string has broken glass stuck to it, and by this device they are enabled to cut the strings of other kites. (In Japan a device holding a sharp cutting edge is employed for the same purpose.) Children also play jackstones, using seven balls and having many ways of picking them up; these ways have their special names, such as "Hatch the chicken," "Laying eggs," "Making the kitchen," "Sawing wood," "Winnowing wheat," "Collecting eggs," "Striking ground," "Wearing the hat," etc. "Pease porridge hot" and "Cat's cradle" are also common; this last is called "Thread dipping."

SUPERSTITIONS.—It is believed that if a cat approaches a dead person the body will stand upright. In such a case it must be

knocked down with a broom from the left. In Japan a similar superstition prevails. In eating rice (which is always eaten with a spoon), if the first spoonful is accidentally spilled it is a sign of bad luck. My informant's father often did this, and purposely challenged other superstitions as well, to show his contempt for them. In parties meeting together it is desirable to have an odd number, as in two, four, six, etc., there is an end, while in three, five, seven, and the like, there is no end; hence thirteen at the table is considered a lucky number. If a bride, in coming to her husband's house, stops on the threshold, it is a sign of bad luck. A horseshoe fastened over the door is to invite good luck. Bad dreams are, as with us, neutralized by saying that dreams go by contraries. If the hat is blown off by the wind it is a sign that something will be lost. In occupying a new house it is customary to have a woman, either the wife or a servant, enter first, carrying a bunch of matches; this insures prosperity, as a flame burning up. To avert infectious diseases, it is believed that a paper obtained from a priest and fastened over the door will be effective. A fierce face carved out of wood and placed over the door will drive away diseases which are supposed to be brought by the devil; also the burning of strong incense will have the same effect. Nothing can be removed from the house structure without vigorous protest from the womenfolks. (The women in Korea, as elsewhere, are the conservers of superstition. Old women, even in the higher classes, are superstitious, though there are some exceptions.) If the removed portion is to be replaced by other structures, then no objection is made, but to take anything away from the house structure without substituting something else is considered a bad omen. If a coal gathers on the lamp wick, it is a sign that one is to receive money, or some lucky windfall; so fixed is this superstition that many will not remove the coal. In Japan also this is considered a good omen. If the ear itches, it is a sign that some one is talking about you. If the chin itches, it is a sign that candy or cake will come as a gift. If one dreams of a Buddhist priest, it is a sign of being poisoned. A certain bird singing in a tree near the house presages the coming of a guest. If an owl hoots near the house, it is a sign that the master will soon die. If a fragment of tea floats vertically in the cup, it is a sign that a guest will come. If a candle is lighted in the middle of supper, it is a sign that the boys will get fierce wives. If money is found, it is considered a sign of bad luck, as it is gained without labor; an unexpected calamity will occur unless the money is spent before entering the house. If one accidentally places his spoon on the table upside down, it is a bad sign. If one's boot is upside down, it is considered bad; one will remain in the house if this happens rather than risk the consequences,

which are, that he will lose something or be insulted. If both boots are wrong side up, it means nothing.

When lying down to sleep it is considered best to have the head directed toward the south. The head pointing toward the north is considered very bad. If the head is directed toward the south, it indicates longevity; to the east, happiness; to the west, success; to the north, short life. If one eats during lunar or solar eclipses sickness will follow. In Japan it is considered proper to remain indoors during eclipses. In Korea drums are vigorously beaten, to drive away the assailant of the sun or moon. This is a Chinese idea. An eclipse is observed by its reflection in a vessel of water. In Japan the same thing is done, because it is considered impolite to look directly at the eclipse. Shooting stars are supposed to be the excreta of stars. Farmers have an idea that the moon is trying to catch the sun, and if the moon ever overtakes the sun they will both fall to the earth, pressing the surface below the water, and thus the world will come to an end. A country philosopher told one of my informants that the sun was many hundred times larger than the earth, that the moon was three times larger than the earth, and that all the stars were much larger than the earth. Lightning is supposed to be the result of God looking angry, while thunder is supposed to be God scolding. It is considered rude to lie down when God is scolding. The lower classes believe that if insanity occurs three or four times in a year it is an indication of the devil's work. Gypsies are called in to drive the devil away by incantation. Intelligent doctors look upon insanity as the result of physical disease—namely, that the fire of the heart burns in excess. They also believe that some hearts are chilled, and that other hearts are empty. Cases of insanity are not common, and cases of idiocy had never been seen by my informant, though he had heard of instances. It is believed that when a certain river becomes filled with sand Korea will become powerful, and so it is a custom with many people in passing this river to throw in sand. The true-lover's knot is the same as ours. A ring around the moon is a sign that it will rain; the larger the ring the sooner the rain will come. The accidental breaking of a mirror is a sign that death will occur in the family. After the birth of a child persons can not enter the house for three days, nor can animals be killed for three days.

If a man's eyes have more white than black he will become foolish. Tapering or pointed fingers are looked upon as indicating dexterity. A long arm is considered an indication of wisdom, and its owner will occupy a high official position. In Japan the same peculiarity indicates a thief, which may be regarded as only another name for a Korean official. A large eye is a sign of short life. Physiognomists interpret many features of the face; thus a

curved line extending from the lobe of the nose on each side is a sign of starvation.

Palmists also exist in Korea; thus the line of life in the left hand indicates long life, as it does in our palmistry; the same line in the right hand, however, indicates position. A line corresponding to our line of heart in the left hand indicates riches, while the same line in the right hand indicates power. The number of wrinkles at the base of the little finger, on the outside in the left hand indicates the number of brothers one will have, while in the right hand it indicates the number of sons to be expected. Other lines occur in the palm of the hand between the line of life and the line of heart, and these often have a fanciful resemblance to some Chinese character. A combination of these lines resembling the character for water is considered most propitious, because water is unlimited, and man can not do without it. Here the Korean chiromancer is far ahead of his Occidental brother in idiocy, for he can make out many ideograms in the fortuitous wrinkles in the center of the palm.

A familiarity with the language would undoubtedly reveal many peculiarities of expression; thus, for "Excuse me," they say "Do not blame me." "Naked truth" is called "Blood truth." Where we say "Neither hay nor grass," the Korean says "Neither calf nor colt." A house fly is called *parri* which means slanderer; the connection is obscure till it is explained that a fly leaves a light spot on a dark surface and a dark spot on a light surface. Among the sayings is "Rare as a white-headed crow"; in Japan it is a "horse's horn"; with us it is "hen's teeth." A mean man is one who gets his smoke by asking for a light from another man's pipe. In Japan the same expression occurs; also in Japan a mean man is one who finds his clogs in the dark by rapping his friend's head; the light emitted from such a blow is supposed to illuminate the vicinity. Our expression "The devil is always near when you are talking about him" is rendered in Korean "Even the tiger comes"; in Japan it is said "his shadow appears." A stupid fellow in Korea is called a "pumpkin face"; in Japan, a "pumpkin fellow"; with us he is a "pumpkin head."

MISCELLANEOUS.—Twins at a birth are not uncommon, but triplets are very rare. When the latter event occurs the Government makes a present of money to the amount of fifty dollars to the parents, besides furnishing rice for two months.

A Korean gentleman told me that when he first saw the Japanese he regarded them as savages, but was much struck with the convenience of their dress. Another informed me that his father sent him into the country to learn farming, at the same time instructing the farmer who was to have the care of him to provide only the ordinary food of the farmhouse. The young man's

mother, however, used to send him secretly nice food and delicacies.

Among ignorant people the impression of the hand is signed as an autograph to legal documents, but never to marriage documents.

Human statues are not made at the present time, but in olden times figures of large size were sculptured in wood and stone.

Reddish hair and beard and blue eyes are not unknown; my informant had seen a number of such cases.

The classes of the people in Korea rank much as they do in Japan; they are in the following order: 1. Nobles. 2. A class like the Japanese *samurai*, which is inherited. 3. Soldiers. In Japan the teachers would come third, but they have no rank in Korea. 4. Farmers. 5. Merchants. 6. Coolies. 7. Butchers, peddlers, and gypsies.

Suicide is uncommon. When it occurs it is among the country people. Forms of suicide are usually hanging, the taking of poison, inhaling fumes of charcoal, and cutting the throat; the most usual form is that of hanging. My informant had never heard of more than four or five instances of suicide. Infanticide is not known. People in the western part of Korea often kill each other in fights. A curious story was told me by a Korean, who vouched for its truth. Two men, strangers to each other, were stopping at a hotel; one of them went away forgetting to pay his bill; the other paid his bill, and, on leaving, the landlord demanded pay for the one who had defaulted, supposing him to be his friend. This he refused to do, and a dispute over the matter led to a fight, in which the landlord was accidentally killed. The man who had forgotten to pay heard of the row and murder, and hastened back and inquired of the other why he killed the landlord. Explanations followed, and the forgetful man, in remorse at having been the cause of such a tragedy, killed himself; whereupon the survivor, in horror at having caused the death of two, immediately committed suicide.

A brutal sport is not uncommon wherein men engage in stone-throwing, and a number are often killed outright. It is considered a great feat if one can catch a stone and return it. They also fight with sticks and clubs. Boys imitate the men in these kinds of fights.

The Koreans regard their country as possessing eight remarkable objects: 1. An artificial pond thirty miles in length. 2. A mountain known as Kumgansan, having twelve thousand peaks of white stone. This may be the mountain known as Pak-tu, or White Head, which is likened to a piece of porcelain with a scalloped rim. The flora is said to be white, and the mammals white-haired. (If true, a case of protective coloration.) 3. A hole in

the mountain from which the wind constantly blows. 4. A building in the southern part of Korea which has one room having the dimensions of one thousand squares; one square has the dimension of seven feet each way; the floor equals an acre in extent. 5. A beach composed of water-worn stones assuming the shapes of wild beasts, cattle, mountains, and other forms. (Objects of this kind are often seen mounted on little teakwood stands in Japan and China.) 6. A river called by a Korean name which means "against sand"—in other words, it is believed that the water flows in one direction while the sand runs in an opposite direction. 7. A flute one thousand years old, and only one man has been known who could play on it. 8. A stone Buddha.

An examination of Korean objects of manufacture, as exhibited in the United States National Museum, and in the Museum of the Peabody Academy of Science in Salem, will convince one of the degraded condition of the people. The rude musical instruments, rude pottery, rough work generally, and the almost complete absence of all industrial art handwork, testify to the alarming decay of the nation. Flanked as Korea is by China on the one hand and Japan on the other, with their advanced industries and skillful art handwork, and possessing, as Korea does, the records of a great past, the degradation and decay that have come upon the nation must have come about through their own fault. Repeated demands for an explanation of these conditions only brought out the answer that a noble could ruthlessly claim from the artisan any work he might do, and this without recompense. As a result, all ambition is crushed, and the workman dares not attract the attention of these official sharks by fabricating anything of special excellence. From hand to mouth they live; the masses are in abject poverty, and the only comforts they appear to command are heat and tobacco. The corruption of the official class makes Tammany officials seem like white-robed angels.

CONCLUSION.—If my various questions have been correctly answered, one may glance at the preceding statements and realize in how many ways the habits and customs of the people prevent work, discourage industry, and in a surprising number of instances encourage the survival of the unfittest. The appalling waste of time, the degrading habits of life, and the avarice and oppression of the official class illustrate in a forcible manner the result of unnatural selection. When one learns, for example, that custom, following Confucian doctrines, commands an industrious brother to waste his energies in supporting a number of idle, dissolute brothers, thus permitting them to survive to transmit their lazy and vagabond tendencies, one can easily understand the present degradation of the people.

Despite these lamentable conditions, there is a leaven in the nation which may work for regeneration if the accursed and sterilizing effects of Chinese influence and dominion can be rooted out of the land. I have met Koreans of the highest character, noble, unselfish, possessing every lovable trait and animated by the highest patriotism, and these men may yet be heard from in the councils of the nation.

THE RACIAL GEOGRAPHY OF EUROPE.

A SOCIOLOGICAL STUDY.

(*Lowell Institute Lectures, 1896.*)

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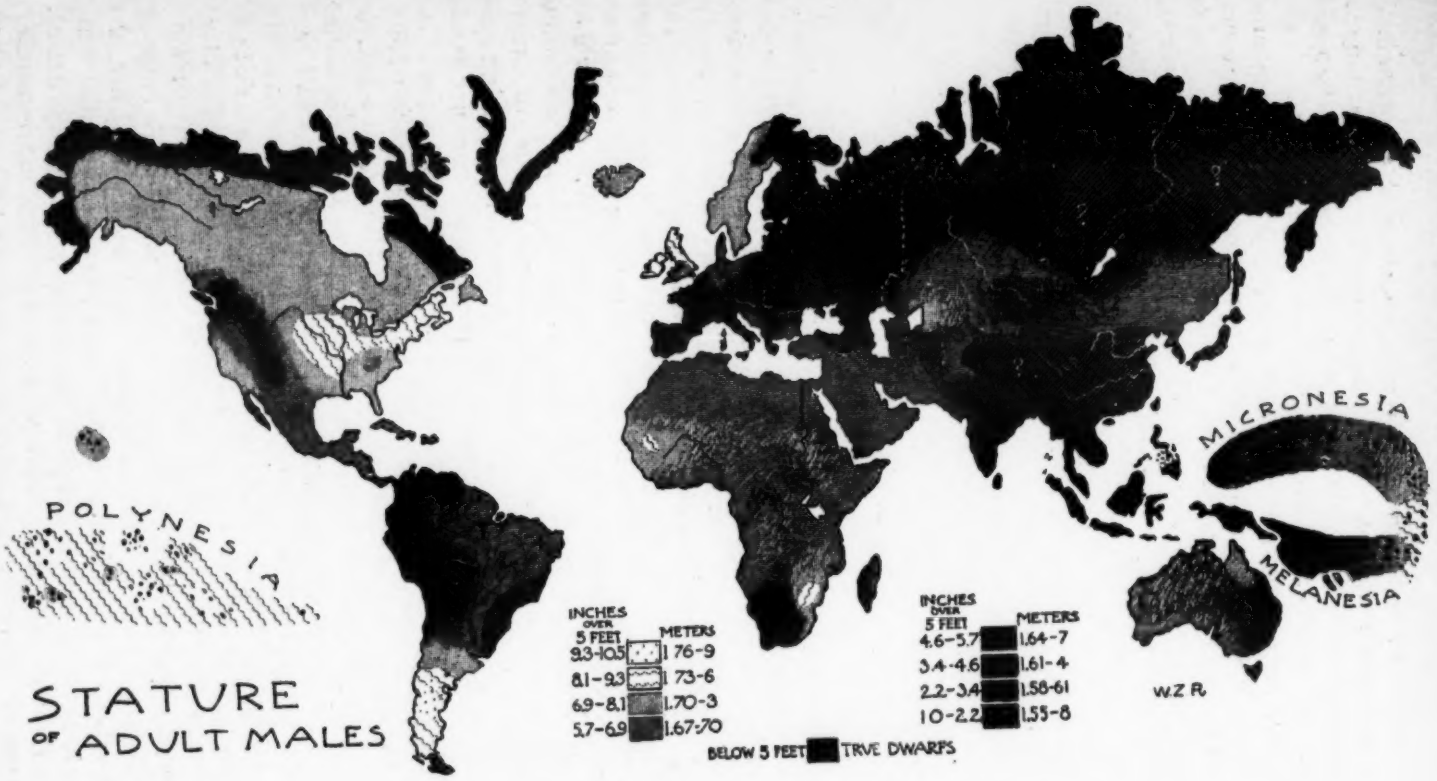
IV.—STATURE.

THE average stature of man, considered by racial groups or social classes, appears to lie between the limits of four feet four inches and five feet ten inches, giving, that is to say, a range of about one foot and a half. The physical elasticity of the species is not, however, as considerable as this makes it appear. The great majority of the human race is found restricted within much narrower limits. As a matter of fact, there are only three or four groups of really dwarfed men, less than five feet tall. Our map of the world shows a considerable area inhabited by the diminutive Bushmen in South Africa, and another large body of dwarfs occurs in New Guinea. The line of demarcation in the first case between the yellowish African Bushmen and the true negroes is very sharp; but in the East Indies the very tall and light Polynesians shade off almost imperceptibly in stature through Melanesia into the stunted Papuans. Other scattering representatives of true dwarf races occur sporadically throughout the Congo region and in Malaysia, but their total number is very small. On the whole, considerably more than ninety-nine per cent of the human species is above the average height of five feet and one inch; so that we may still further narrow our range of variation between that limit and five feet ten inches. We thereby reduce our racial differences of stature to about nine inches between extremes. These variations in size, it will be observed, are less than those which occur among the lower animals within the same species. Compare, for example, the dachshund, the St. Bernard, the Italian greyhound, and the smallest lapdog, and remember that they are all ascribed to the same species; or that the Shet-


POLYNESIA
MICRONESIA
MELANESIA
STATURE
OF ADULT MALES
INCHES OVER 5 FEET
METERS
9.3-10.5
1.76-9
8.1-9.3
1.73-6
6.9-8.1
1.70-3
5.7-6.9
1.67-70
INCHES OVER 5 FEET
METERS
4.6-5.7
1.64-7
3.4-4.6
1.61-4
2.2-3.4
1.58-61
1.0-2.2
1.55-8
BELOW 5 FEET
TRUE DWARFS
W.Z.R.

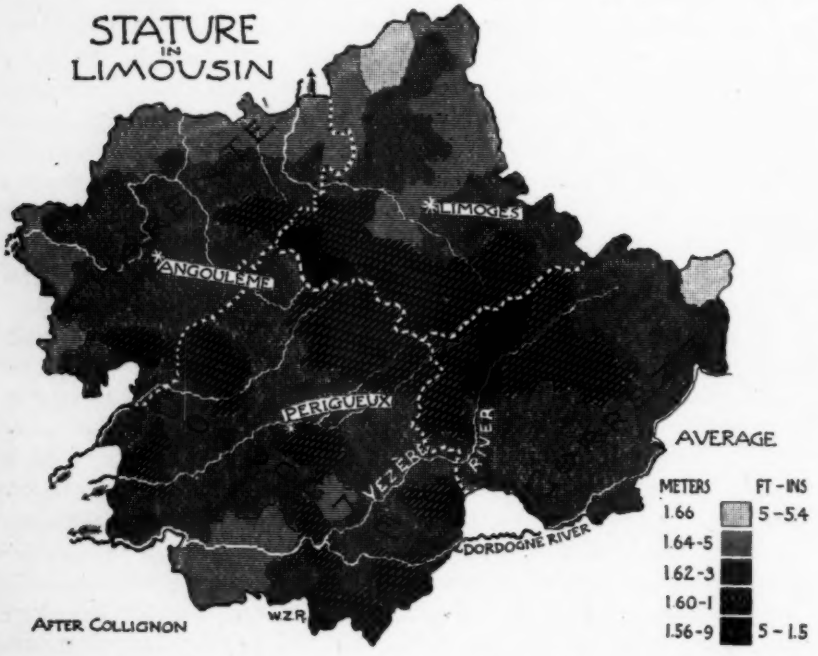
land pony and the Percheron horse are likewise classified together. These abnormities are, to be sure, partly the result of artificial selection by man; but the same variation holds to a considerable extent among the wild animals.

The bodily height of a group of men is the resultant of a number of factors, many of which are as purely artificial as those concerned in the domestication of animals. These causes are quite as truly social or economic as they are physical or physiological. Among them we may count environment, natural or artificial selection, and habits of life. Beneath all of these, more fundamental than any, lies the influence of race which concerns us ultimately. This is overlaid and partially obscured by a fourth peculiarity manifested as a result of the sportiveness of Nature, whereby a large number of variations are due to chance, seemingly not caused by any distinct influences whatever. By scientific analysis we may eliminate this last factor, namely, chance variation. The first four causes besides race are more important and deserve consideration by themselves.

Among savages it is easy to localize the *influence of environment,* as it acts directly through limitation of the food supply. In general, the extreme statures of the human species are found either in regions where a naturally short race, like the Bushmen of South Africa, are confined within a district of great infertility like the Kalahari Desert; or, on the other hand, where a naturally tall race, like the Polynesians in the Pacific Ocean, enjoys all the material bounties which Nature has to bestow. It is probable that the prevalent shortness of the Eskimo and other inhabitants of the arctic regions is largely due to this factor. It is also likely that the miserable people of Terra del Fuego are much shorter than the Patagonians for the same reason. Scarcity or uncertainty of food limits growth. Wherever the life conditions in this respect become changed, in that place the influence of environment soon makes itself felt in the average stature of the inhabitants. Thus the Hottentots, physically of the same race as the Bushmen, but inhabiting a more fertile region, and, moreover, possessed of a regular food supply in their flocks and herds, are appreciably taller from these causes alone. All the aborigines of America seem to be subject to this same influence of the fertility of their environment. In the Mississippi Valley, for example, they are much taller than in the desert lands of Arizona and New Mexico. In the mountains on either side of the Mississippi basin, they are as a rule distinctly shorter, although living the same life and belonging to the same race. The Creeks and the Iroquois exceed the Pueblos by several inches, probably because of the material bounty of their environment; and where we find a single tribe, such as the Cherokees, inhabit-

ing both the mountains and the plains, we find a deficiency of stature in the mountains quite marked by comparison.*

Among civilized peoples this direct influence of environment acts likewise through the food supply to affect the stature of any given group of men. Thus, in Europe as a rule, it may be said that, as among the aborigines of America, the populations of mountainous districts are shorter than those which enjoy the fertility of the plains and the river basins.† Wherever the geology of a district has produced a soil which yields with difficulty to



cultivation, or where the climate is unfavorable to prosperity, the influence is reflected in the physical stature of the population. All over Europe we may locate such "misery spots," one of which will, however, serve as an example. It is depicted in the accompanying map.

This spot is likewise indicated in the south central part of France upon our general map for Europe, on page 30, by a small black-dotted area. This means a general average stature of five feet and two to three inches—a low level not elsewhere touched

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* Dr. Boas, in Verhandlungen der Berliner anthropologischen Gesellschaft, Sitzung von Mai 18, 1895, gives fine details on the American aborigines.

† Ranke, in his Beiträge zur physischen Anthropologie der Bayern, finds the mountaineers taller in his country; but Dr. Livi proves the opposite for Italy. *Vide* also Der Mensch, ii, p. 126.

in France save in a little spot to the southwest of this, where similar conditions prevail. Here in Limousin there is a barren range of low hills which lies along the dividing line between the departments of Dordogne, Corrèze and Haute-Vienne, about halfway between Périgueux and Limoges. The water courses on our map show the location of these uplands. They extend over an area about seventy-five miles long and half as wide, wherein average human misery is most profound. Dense ignorance prevails. There is more illiteracy than in any other part of France. The contrast in stature, even with the low average of all the surrounding region, is clearly marked by the dark tint. There are sporadic bits of equal diminutiveness elsewhere to the south and west, but none are so extended or so extreme. Two thirds of the men are below five feet three inches in height in some of the communes, and the women are three or more inches shorter even than this. One man in ten is below four feet eleven inches in stature. This is not due to race, for several racial types are equally stunted in this way within the same area. It is primarily due to generations of subjection to a harsh climate, to a soil which is worthless for agriculture, to a steady diet of boiled chestnuts and stagnant water, and to unsanitary dwellings in the deep, narrow, and damp valleys. Still further proof may be found to show that these people are not stunted by any hereditary influence, for it has been shown that children born here, but who migrate and grow up elsewhere, are normal in height; while those born elsewhere, but who are subject to this environment during the growing period of youth, are proportionately dwarfed.*

We have referred in the preceding paragraph to another similar "misery spot" to the southwest of the Limousin hills. It is dotted black upon the map of Europe. The cause is here the same. The department of Landes derives its name from the great expanse of flat country, barely above the sea level, which stretches away south of Bordeaux. There is no natural drainage slope. The subsoil is an impervious clay. In the rainy season, water accumulates and forms stagnant marshes, covered with rank vegetation. At other times the water dries away, and the vegetation dies and rots. Malaria was long the curse of the land. Government works are to-day reclaiming much of it for cultivation and health, but it will be generations before the people recover from the physical degeneration of the past. Influences akin to these have undoubtedly been of great effect in many other parts of Europe, especially in the south of Italy, in Sardinia and Spain, where the largest area of short statures in Europe prevails to-day.

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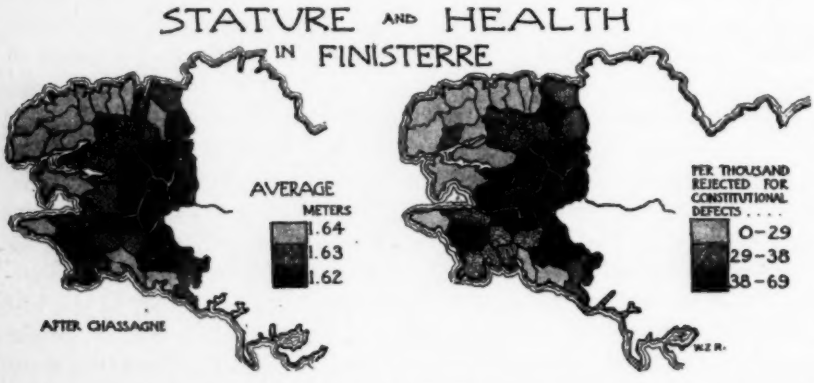
* Collignon in Mémoires de la Société d'Anthropologie, series iii, vol. i, fasc. 3, pp. 32 *seq.*

Environment thus acts directly upon stature through the food supply and economic prosperity. The second modifying influence lies in so-called *artificial selection*—a cause which is peculiarly potent in modern social life. The efficiency of this force depends upon the intimate relation which exists between bodily height and physical vigor. Other things being equal, a goodly stature in a youth implies a surplus of energy over and above the amount requisite merely to sustain life.* Hence it follows that, more often than otherwise, a tall population implies a relatively healthy one. Our double map, covering the westernmost promontory of French Brittany, shows this most clearly. In the interior cantons, shorter on the average by an inch than in towns along the seacoast, there is a corresponding increase of defective or degen-



erate constitutional types. The parallelism between the two maps is broken in but three or four instances. The map, in fact, illustrates the truth of our assertion far better than words can express it.

This relation between stature and health is brought to concrete expression in the armies of Europe through a rejection of all recruits for service who fall below a certain minimum standard of height, generally about five feet. The result of this is to preclude the possibility of marriage for all the fully developed men, during their three years in barracks; while the undersized individuals, exempted from service on this account, are left free to propagate the species meanwhile. Is it not apparent that the effect of this artificial selection is to put a distinct premium upon inferiority of stature, in so far as future generations are concerned? This enforced postponement of marriage for the normal man, not required of the degenerate, is even more important than at first sight appears. It implies not merely that the children of

* The two maps by Chassagne on Brittany are given in Revue d'Anthropologie, series ii, vol. iv, p. 440.

normal families are born later in life—that would not be of great moment in itself—it means far more than this. The majority of children are more often born in the earlier half of married life, before the age of thirty-five. Hence a postponement of matrimony means not only later children but fewer children. Herein lies the great significance of the phenomenon for us. Standing armies tend in this respect to overload succeeding generations with inferior types of men. This selection is, in operation, akin to the influence which Galton has invoked as a partial explanation for the mental darkness of the middle ages. This he ascribes to the beliefs and customs by which all the finer minds and spirits were withdrawn from the field of matrimony by the Church, leaving the entire future population to the loins of the physically robust and adventurous portion of the community. Mind spent itself in a single generation of search for knowledge; physique, bereft of intellect, was left to its own devices among the common people.

The intensity of this military selection, potent enough in time of peace, is of course highly augmented during the prosecution of a war. At such periods the normal men are not only isolated for an indefinite period; their ranks are permanently decimated by the mortality at the front. The selective influence is doubly operative. Fortunately, we possess data which appear to afford illustration of its effects. Detailed investigation in various parts of France is bringing to light certain curious after-effects of the late Franco-Prussian War. We do not always fully realize what such an event means for a nation, quite irrespective of the actual mortality, and of the direct economic expenditure. Every family in the land is affected by it; and the future bears its full share with the contemporaneous population. In France, for example, during the year of the war, there were seventy-five thousand fewer marriages than usual. In 1871, upon its conclusion, an unprecedented epidemic of them broke out, not equaled in absolute numbers since the veterans returned from the front in 1813, on the cessation of hostilities at that time.

Two tendencies have been noted, from the comparison of the generations of offspring severally conceived before, during, and after the war. This appeared in the conscripts who came before the recruiting commissions in 1890–'92, at which time the children conceived in war times became, at the age of twenty, liable for service. In the population during the progress of the war the flower of French manhood, then in the field, was without proportionate representation. There must have been an undue preponderance, not only of stunted men, rejected from the army for deficiency of stature alone, but of those otherwise physically unfitted for service. Hence, the population born of this time ought,

if heredity means anything, to retain some traces of its relatively degenerate derivation. This is indeed the case. In Dordogne this contingent included nearly seven per cent more deficient statures than the normal average. Quite independently, in the distant department of Herault, Lapouge discovered the same thing. He found in some cantons a decrease of nearly an inch in the average stature of this unfortunate generation, while exemptions for deficiency of stature suddenly rose from six to sixteen per cent.* This selection is not, however, entirely maleficent. A fortunate compensation is afforded in another direction. For the generation conceived of the men returned to their families at the close of the war has shown a distinctly upward tendency almost as well marked. Those who survived the perils and privations of service were presumably in many cases the most active and rugged; the weaker portion having succumbed in the meanwhile, either to wounds or sickness. The result was that the generation conceived directly after the war was as much above the average, especially evinced in general physique perhaps more than in stature, as their predecessors, born of war times, were below the normal.

Another illustration of the operation of artificial selection in determining the stature of any given group of men appears in the physique of immigrants to the United States. In the good old days when people emigrated from Europe because they had seriously cast up an account and discovered that they could better their condition in life by coming to America—that is, before the days when they came because they were overpersuaded by steamship agents, eager for the commissions on the sale of tickets, or because of the desire of their home governments to be rid of them—in those days investigation revealed that on the average the immigrants were physically taller than the people from whom they sprang. This difference, in some instances, amounted to upward of an inch upon the average. Among the Scotch, a difference of nearly two inches was shown to exist by the measurements taken during our civil war. These immigrants were a picked lot of men—picked, because it required all the courage which physical vigor could give to pull up stakes and start life anew. This law that *natural* emigrants, if I may use the term, are taller than the stay-at-home average was again exemplified during the civil war in another way. It was found that recruits hailing from States other than those in which they were born were generally taller than those who had always remained in the

* For further details, *vide* the excellent analysis by Dr. Collignon, in Mémoires de la Société d'Anthropologie, Paris, series iii, vol. i, p. 36 *seq.*, and Dr. Lapouge, in Les Selections Sociales, pp. 208 and 234 *seq.* A most noteworthy treatise in many ways. *Vide* also Bulletin de la Société Languedocienne de Geographie, xvii, p. 355 *seq.*

places of their birth—that is to say, here again physical vigor and the adventurous migratory spirit seemed to stand in close relation to one another.*

In times of peace, perhaps the most potent influence of this form of artificial selection bears upon the differences in stature which obtain between different *occupations* or *professions*. The physically well developed men seek certain trades or occupations in which their vigor and strength may stand them in good stead: on the other hand, those who are by nature weakly, and coincidently often deficient in stature, are compelled to make shift with some pursuit for which they are fitted. Thus, workers in iron, porters, firemen, policemen are taller, as a class, than the average, because they are of necessity recruited from the more robust portion of the population. In marked contrast to them tailors, shoemakers, and weavers, in an occupation which entails slight demands upon the physical powers, and which is open to all, however weakly they may be, are appreciably shorter than the average. Moreover, certain diseases fall upon this second class in a way which tends still further to lower the average stature among them. Thus, consumption is uncommonly prevalent in these particularly sedentary industrial classes, and it is also more common among tall youths. It seems, therefore, that this disease weeds out, as if by choice, those who within this relatively stunted class rise above its average. As an extreme example of this selective influence exercised in the choice of an occupation we may instance grooms, who as a class are over an inch shorter than the British population as a whole. This is probably because men who are light in build and short in stature find here an opening which is suited to their physique. Their weight may nevertheless be often greater than the stature implies, because of an increase which has taken place late in life.

The final effects of this influence of artificial selection are highly intensified by reason of the fact that, as soon as the choice of occupation is once made, other forces come into play which differentiate still further the stature of the several classes. This is the last of our modifying influences upon racial stature, namely, the effect of *habits of life or of the nature of the employment*. Thus, the weakly youth who enters a sedentary occupation immediately becomes subjected to unfavorable circumstances as a

* For most of the examples of social and economic differences in stature, I am indebted to Dr. Beddoe for his superb work On the Stature and Bulk of Man in Great Britain; to the Anthropometric Committee of the British Association for the Advancement of Science, report of 1883; to Roberts's Manual of Anthropometry; and to our American results given in Gould's Investigations in the Military and Anthropological Statistics of American Soldiers, 1869; and Baxter, in Medical Statistics of the Provost-Marshal-General's Bureau, 1875.

result of his choice. If he chooses to take up the tailor's trade because he is physicaly unfitted for other pursuits, all the influences of the trade tend to degenerate his physique still further. Among these we may count the cramped position in which he works, the long hours, the unsanitary surroundings, etc. An active life conduces to growth and vigor, especially an active life in the open air. Denied all these advantages, everything operates to exaggerate the peculiarities which were due to natural causes in the preceding generation alone. This direct influence of the nature of the employment is probably the second principal cause of the great differences in stature which we observe among the several social classes in any community. At the head stand the liberal professions, followed in order, as our table shows, by the farmers and the commercial group, then by the industrial

Average Stature in Inches (Great Britain).

No. of observations.	Age (males).	Professional class.	Commercial class.	INDUSTRIAL CLASS.	
				Country.	City.
3,498	15 years.	63·6	62·2	61·8	61·3
592	23 "	68·7	67·4	67·4	66·4
1,886	30–40 "	69·6	67·8	67·6	66·8

Averages by Occupations.

No. of observations.	Occupation.	Stature (inches).	Weight (pounds).
174	Miscellaneous outdoor	67·6	142·0
242	Clerks	67·3	136·7
834	Laborers	67·1	140·0
209	Iron-workers	67·1	140·0
135	Tailors and shoemakers	66·9	134·5
235	Miscellaneous indoor	66·7	132·5
101	Grooms	66·5	138·7

open-air classes, and finally by those who are engaged in indoor and sedentary occupations. The difference between these last two—namely, those who work in the open air and those who are confined within doors—amounts in Great Britain to upward of one half an inch upon the average, if we consider masons, carpenters, and day laborers as typical of the first class, and tailors and shoemakers of the second. As our table shows, the differences during the period of growth often amount to upward of two inches, greater among girls than among boys. As an extreme example of divergencies of this kind, we may instance a difference of seven inches between boys of fourteen in the well-to-do classes and those who are in the industrial schools in Great Britain. Later in life this disparity becomes less, as it appears that the

influence of factory life is more often to retard growth than to cause a complete cessation of it.

Interesting deductions might also be drawn from the relation of the height to the weight in any class, by which we may determine to some degree when and how these degenerative influences become effective. Thus clerks, as a class, are above the average stature, but below it in weight. This follows because these men are recruited from a social group where the influences during the period of growth are favorable. The normal stature was attained at this time. The unfavorable circumstances have come into play later through the sedentary nature of the occupation, and the result is a deficiency in weight. The case of grooms given above is exactly the reverse of this, for they became grooms because they were short, but have gained in weight afterward because the occupation was favorable to health.

These differences in stature within the community offer a cogent argument for the protection of our people by means of well-ordered factory laws. The Anthropological Committee of the British Association for the Advancement of Science delares, as a result of its detailed investigation, that the protection of youth by law in Great Britain has resulted in the gain of a whole year's growth for the factory children. In other words, a boy of nine years in 1873 was found to equal in weight and in stature one of ten years of age in 1833. This is nature's reward for the passage of laws presumably better than the present so-called "beneficent" statute in South Carolina which forbids upward of eleven hours' toil a day for children *under* the age of fourteen. In every country where the subject has been investigated—in Germany, in Russia, in Austria, Switzerland, or Great Britain—the same influence is shown. Fortunately, the advance out of barbarism is evidenced generally by a progressive increase in the stature of the population as an accompaniment of the amelioration of the lot of the masses, which is certainly going on decade by decade, absolutely if not relatively. There is no such change taking place among the prosperous and well-to-do. It is the masses which are, so to speak, catching up with the procession. It offers a conclusive argument in favor of the theory that the world moves forward.

One of the factors akin to that of occupation which appears to determine stature is the unfavorable *influence of city life.* The general rule in Europe seems to be that the urban type is physically degenerate. This would imply, of course, not the type which migrates to the city on the attainment of majority, or the type which enjoys an all-summer vacation in the country, but the urban type which is born in the city, and which grows up in such environment, to enter a trade which is also born of town life.

The differences in stature which are traceable to this influence of city life are considerable. The town population of Glasgow and Edinburgh offers an extreme example wherein the average stature has been found to be four inches less than the average for the suburban districts. The people, at the same time, are on the average thirty-six pounds lighter. Dr. Beddoe, the great authority upon this subject, concludes his investigation of the population of Great Britain by this statement: "It may therefore be taken as proved that the stature of men in the large towns of Britain is lowered considerably below the standard of the nation, and as probable that such degradation is hereditary and progressive."

On the other hand, it must be confessed that this unfavorable influence of city life is often obscured by the great social selection which is at work, as we shall hope to show later, in the determination of the physical type of the population of great cities. While the course of the town type by itself is downward, oftentimes the city attracts another class which is markedly superior, in the same way that the immigrants of the United States have been distinguished in this respect. Taking London as a whole, the stature of its people is apparently above the level of the surrounding districts, despite the unfavorable influences of urban life. At the same time the suburban counties about London are marked by a standard below the average. This follows, probably, from the great selective process by which all of the better types of the rural population are continually being drawn off into the vortex of city life. The effect of it is, of course, to increase the average stature of the town population, taken as a whole.

It would be interesting to inquire in how far the relative height of the *sexes* is due to a similar selective process. Certain it is that among us, in civilization, women average from three to four inches below men in stature, a disparity which is considerably less among primitive peoples. Dr. Brinton has invoked as a partial explanation, at least, for this, the influence of the law of sexual division of labor which obtains among us. This law commands, in theory, that the men should perform the arduous physical labor of life, leaving the more sedentary portion of it to the women. If the conscious choice of mates had followed this tendency, its effect would certainly be unfavorable to the development of an increasing stature among women, while it might operate to better the endowment of men in that respect. It is impossible, in the time at our command, to follow this out. Probably this difference of stature between the sexes is partially due to some other cause which stops growth in the woman earlier than in the man. The problem is too complex to follow out in this place.

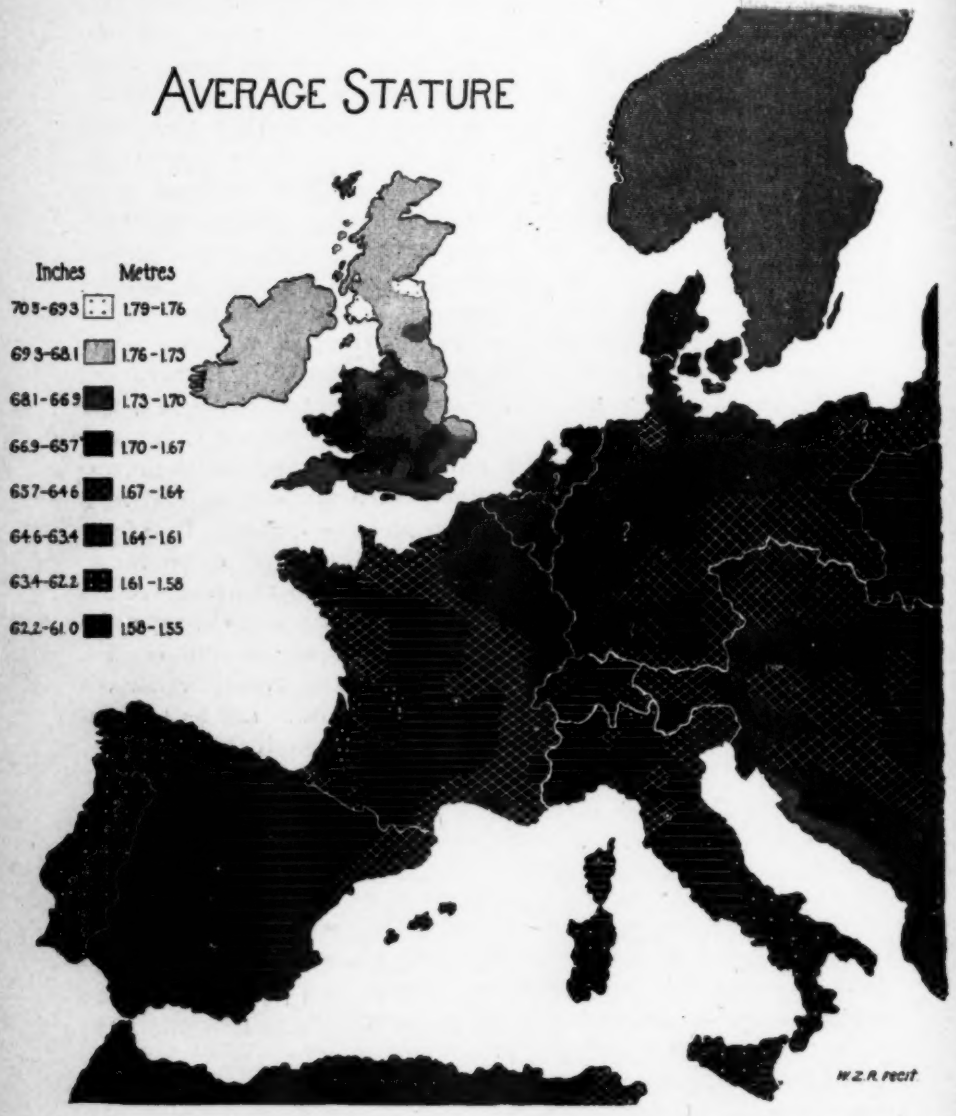
From the preceding array of facts it will appear that in stature we have rather an irresponsible witness in the matter of race. A

physical trait so liable to disturbance by circumstances outside the human body is correspondingly invalidated as an indication of hereditary tendencies which lie within. We are compelled for this reason to assign the third place to this characteristic in our series of racial tests, placing it below the color of the hair and eyes in the scale. This does not mean that it is entirely worthless for our ethnic purposes. There are many clear cases of differences of stature which can be ascribed to no other cause; but it bids us be cautious about judging hastily. It commands us to be content with nothing less than hundreds of observations, and to rigidly eliminate all social factors. The best way to do this is to take the broad view, by including so many individuals that locally progressive and degenerative factors may counterbalance one another. Turning back to our world map of statures, it will at once appear that we can not divide the human species into definite continental groups characterized by distinct peculiarities of stature. The so-called yellow Mongolian race comprises both tall and short peoples. The aborigines of America are, as a rule, tall; but in the Andes, the basin of the Columbia River, and elsewhere they are quite undersized. The only two racial groups which seem to be homogeneous in stature are the true African negroes and the peoples of Indonesia and the Pacific. In Africa the environment is quite uniform. In the other cases racial peculiarities seem to be deeply enough ingrained to overcome the disturbances due to outward factors. The Malays are always and everywhere rather short. The Polynesians are obstinately inclined toward tallness. With these exceptions, racial or hereditary predispositions in stature seem to be absent. Let us turn to the consideration of Europe by itself, and inquire if the same rule holds here as well.

The light tints upon this map* indicate the tall populations; as the tint darkens, the people become progressively more and more stunted. Here again we find that Europe comprehends a very broad range of variations. The Scotch, with an average height of five feet and ten inches, stand on a level with the tall Polynesians and Americans, both aboriginal and modern white. At the other extreme, the south Italians, French, and Spaniards, range alongside the shortest of men, if we except the abnormal dwarf

* This map is constructed from a great number of detailed local investigations, the results of which have been, as far as possible, correlated and reduced to a common base. Many serious difficulties have to be overcome, and the final result must be regarded as merely approximate. For example, some observers have studied the entire population of districts; others draw their figures from the army alone, from which, of course, all the abnormally short men have been eliminated. Some give averages alone; others work by percentile grades. To be sure, these two methods give parallel results; but how discover the average from them? Complete details will be published in due season.

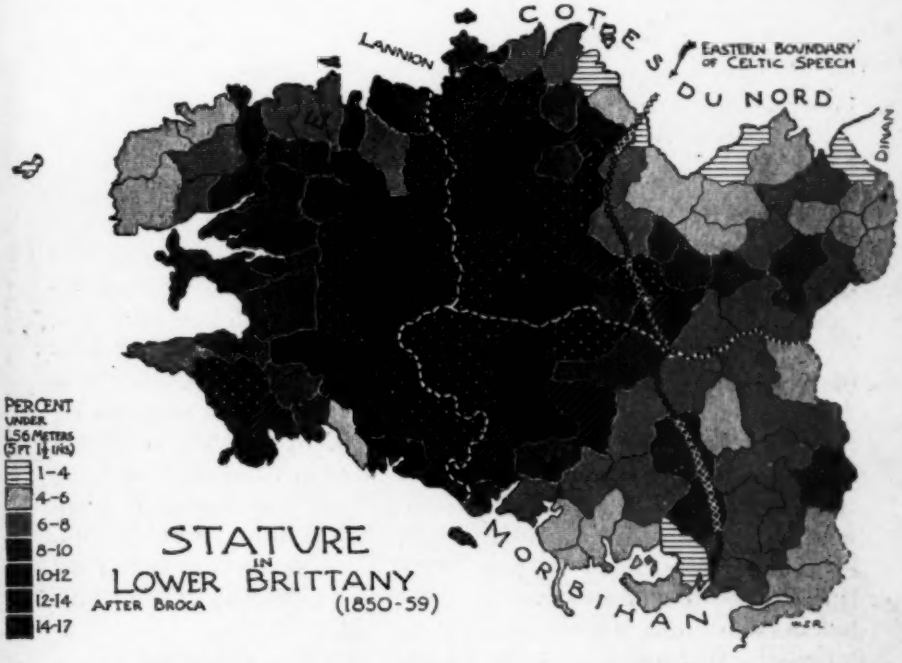
races of Africa. From one to the other of these limits there is a regular transition, which again points indubitably to racial law. Two specific centers of tall stature appear, if we include the minor but marked tendency of the Dalmatians and Montenegrins along



the Adriatic Sea. The principal one lies in the north, culminating in the British Isles and Scandinavia. In Britain, economic prosperity undoubtedly is of importance, as the level of material comfort is probably higher than on the Continent. With this exception it appears that the Teutons as a race are responsible

for the phenomenon. Wherever they have penetrated, as in northern France, down the Rhone Valley, or in Austria, the population shows its effects.

Central Europe is generally marked by medium height. The people tend to be stocky rather than tall. The same holds true as we turn to the Slavic countries in the east of Europe. Across Austria and Russia there is a progressive although slight tendency in this direction. The explanation of the extreme short stature of southern Europe is more problematical. Our map points to a racial center of real diminutiveness, at an average of five feet and one or two inches. Too protracted civilization, such as it was, is partly to blame. Some authorities, notably Lapouge



and Fallot, even assert that naturally the people are as tall as the Alpine populations. Northern Africa certainly favors this view. We must await further investigation on this point, resting content with the fact, whatever the cause may be, that the average stature is exceedingly low to-day.

We may demonstrate the innate tendency of the Teutonic peoples toward tallness of stature more locally than by this continental method. We may follow the trait from place to place, as this migratory race has moved across the map. Wherever these "greasy seven-foot giants," as Sidonius Apollinaris called them, have gone, they have implanted their stature upon the people, where it has remained long persistent thereafter. Per-

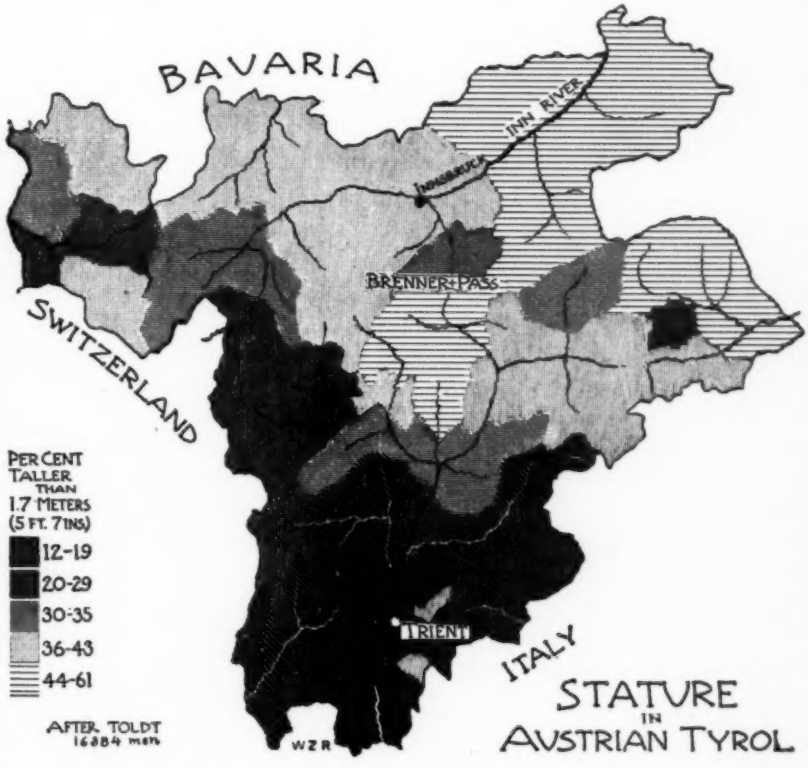
haps the clearest detailed illustration of the expression of this racial peculiarity is offered by the people of Brittany. Many years ago observers began to note the contrasts in the Armorican Peninsula between the Bretons and the other French peasantry; and especially the local differences between the people of the interior and those fringing the seacoast. The regularity of the phenomenon is made manifest by the preceding map. This is constructed from observations on all the youth who came of age during a period of ten years from 1850–'59. There can be no doubt of the facts in the case. It has been tested in every way. Other measurements, made twenty years later, are precisely parallel in their results, as we have already seen in Finisterre.*

The average stature of the whole peninsula is low, being only about five feet and five inches; yet in this "*tache noire*" it descends more than a full inch below this. This appreciable difference is not wholly due to environment, although the facts cited for Finisterre show that it is of some effect. The whole peninsula is rocky and barren. The only advantage that the people on the coast enjoy is the support of the fisheries. This is no insignificant factor, to be sure. Yet we have direct proof beyond this that race is here in evidence; this is afforded by other physical differences between the population of the coast and that of the interior. The people of the littoral are lighter in hair and eyes, and appreciably longer-headed; in other words, they show traces of Teutonic intermixture. In ancient times this whole coast was known as the "*litus Saxonicum*," so fiercely was it ravaged by these northern barbarians. Then, again, in the fifth century, immigrants from Britain, who in fact bestowed the name of Brittany upon the country, came over in hordes, dispossessed in England by the same Teutonic invaders. They were probably Teutonic also; for the invaders of Britain came so fast that they literally crowded themselves out of the little island. The result has been to infuse a new racial element into all the border populations in Brittany, while the original physical traits remain in undisturbed possession of the interior. The Normans to the northeast are, on the other hand, quite purely Teutonic, especially marked in their height. In this case environment and race have joined hands in the final result, but the latter seems to have been the senior partner in the affair.

One more detailed illustration of the persistence of stature as a racial trait may be found in the people of the Austrian Tyrol, familiarized to us in the last paper. Unfortunately, our

* Dr. Chassagne has maps almost identical with this, for the period 1874–'78. *Vide* Revue d'Anthropologie, second series, vol. iv, p. 439 *seq.* Our map is adapted from Broca's original results in Mémoires de la Société d'Anthropologie, Paris, series one, vol. iii, p. 186 *seq.*

present map is constructed by different districts, so that we can not compare valley with valley, as it would be most profitable to do. We have to be content with more general results. For purposes of orientation we have reproduced upon this sketch the rivers shown upon our map in the preceding paper, so that certain comparisons may be drawn. We have already seen that the lower Inn Valley (uppermost in our map) was a main channel of Teutonic immigration into a primitively broad-headed Alpine country by race. On the south up the Adige Valley by Trient came the second intrusive element in the long-headed brunette Medi-



terranean peoples. This map at once enables us to endow each of these with its proper quota of stature; for the environment is quite uniform, considered as in this map by large districts covering valley and mountain alike. Each area contains all kinds of territory; so that we are working by topographical averages, so to speak. Moreover, the whole population is agricultural, saving a few domestic industries in the western half. Such differences as arise must be therefore in large measure due to race. The regular transition from the populations at the northeast, with generally a majority of the men taller than five feet seven inches, to the

Italian slopes, where less than one fifth attain this moderate height, is sufficient proof.* The progressive decline goes on still further as we go south, as our map of Europe has indicated, away down to the toe of Italy's boot. Could demonstration in mathematics be more certain that here in the Tyrol we have a case of an increase of stature due to race alone? One of the most persistent traits of the Teuton is his bodily height. We in America, among the tallest people in the world, owe much of our advantage in this respect to our Teutonic lineage. The rest is due to the high level of prosperity enjoyed by the people in the United States as a whole.

REVERSIONS IN MODERN INDUSTRIAL LIFE.

By FRANKLIN SMITH.

PART SECOND.

I HAVE already shown how modern trade and professional corporations are a reversion to feudal corporations, which were the natural and spontaneous product not of legislative wisdom and philanthropy, but of chronic disorder, and how, for a time, they provided security for despised and plundered toilers, and promoted the growth of civilization. While pointing out the astonishing absurdity involved in the revival of such obsolete institutions in an age devoted almost exclusively to industrial life—a life based upon peace and the largest liberty compatible with justice—I described some of their more flagrant economic evils, the inevitable fruits of their alliance with the state and of their establishment of despotic monopolies. I shall now give an account of some of their moral evils, the fruits also of the same despotism; and though it will, as before, be confined chiefly to the plumbers, because they are the most powerfully organized and the most completely protected, it applies with like fidelity to all other trade and professional corporations sheltered behind a statute or a code of tyrannical rules and regulations.

I.

An optimistic essayist of the National Association of the Master Plumbers may boast that "protection has not only elevated the trade and eliminated from our ranks the incompetent and unworthy," but has "reached out and enhanced man's highest good, and given humanity the greatest benefactions of the age." He may boast also that in consequence of these noble fruits of protection, "the plumber receives the esteem, respect, and honor

* Details are given in Mittheilungen der anthropologischen Gesellschaft in Wien, vol. xxi, 1891, p. 69 *seq.*

of his fellow-men, and enjoys the dignity and consideration given to the learned professions about him."* But the destruction of personal liberty and the establishment of a monopoly in labor and trade did not confer these blessings upon the corporations of the middle ages; they have not conferred them upon their modern successors. Brief as their history is, it discloses all the traits of their predecessors in embryo or in an advanced state of growth. They have not transformed human nature; they have not made it more honest, generous, or sympathetic. All they have done is to add another to the countless demonstrations that the reform of human society is not to come from legislation. They have provoked strife; they have stimulated deception; they have favored incompetency and dishonesty; they have discouraged character and excellence; they have created false hopes; they have produced indifference to the very dangers they were designed to guard against.

The honest plumbers that expected most from this kind of legislation have suffered the greatest disappointment. The making of master plumbers, said Mr. Edward Braden, of San Antonio, Texas, at the Cleveland convention, "is a Herculean job. They love to go to conventions, have a good time, and even ridicule any advancement or strict enforcement of the sanitary laws."† So great does the task appear to be, and so vast is the work still to be done, that it must long remain incomplete. More than that, unless a different course is pursued, it must always remain incomplete. "It would seem," says another plumbing authority, "to be a safe assertion that too many [plumbers] do not have a true conception of the dignity of their calling. Their dominant idea is to do the cheapest work without much thought of the moral obligations resting upon them to guard in every way in their power the health of all concerned."‡ The president of the Milwaukee convention complained that "in several instances parties, after becoming members of the National Association," have "endeavored to use their membership to keep other practical and worthy plumbers out."* Not finding the time ripe for such mediæval proscription, some of them have preferred to forego the benefits of the association. Other plumbers, equally oblivious to the "dignity of their calling," have been dishonest enough to conspire with the jobbers and consumers to violate the sanctity of the Baltimore resolutions. One of the more striking cases was the collusion of a plumber and jobber in one State with a consumer in another several hundred miles away.‖ "Many

* Proceedings, Cincinnati, 1891, pp. 129, 131. † Proceedings, Cleveland, 1896, p. 96.
‡ Proceedings, Washington, D. C., 1892, p. 80. * Proceedings, Milwaukee, 1893, p. 71.
‖ Proceedings, Cleveland, 1896, p. 145.

contractors," says the account of another case, which duplicates almost literally the experience of the Parisian *marchands de l'eau*,* showing again how independent of time and space, of feudal despotisms and despotic republics human nature is, "induce journeymen plumbers to take out licenses so that they can give the money to the journeymen and get the goods at plumbers' prices. Too often they do not go through the formality of having the money pass through the journeymen's hands. "It is to be regretted," adds the account mournfully, "that some supply houses sell to such so-called plumbers when they know the circumstances." †

As in the past, so to-day, the desperate attempt made to fence off trades and professions with the barbed wire of legislation, and to grant admission to the sacred circles of monopoly only to those that meet official standards of excellence, has led to the creation of absurd and arbitrary distinctions and provoked fierce anger and contention. Already the opticians of Pennsylvania distinguish between opticians, dioptricians, and ophthalmotricians,‡ thus reminding one of the five kinds of hat makers in old France, and when they come to get a law enacted for their protection, these distinctions will doubtless be perpetuated in the statutes, to the instruction and amusement of some future Montesquieu. In the bill that the New York opticians have framed the line is drawn with scrupulous care between "dispensing opticians," who sell the products of the industrial skill of others, and "refracting opticians," # who dispose of the products of their own skill. But hardly had the measure been published before there was a quarrel, or rather a series of quarrels, that rivaled any that the regulations of the French hat makers stirred up. There was, first, the fight between the regular physicians, who claim, by virtue of their diplomas from medical colleges, the right to prescribe for optical defects, and the oculists and opticians, who want to establish a monopoly of this business. Next came the fight between the oculists, who assert that they alone have the requisite knowledge and skill to practice their profession, and the "refracting opticians," who insist that they are just as competent to prescribe in certain cases. "When it is remem-

* "Il est vrais que l'on employoit . . . bien de ruses pour éluder les lois rigoureuses imposées au commerce par le hanse. Les contrebandiers trouvoient dans le corps même des marchands de l'eau des hommes assez complaisans pour être les compagnons légaux des spéculateurs étrangers, et qui, dans le fait, se contentoient de prêter leur nom, sans prendre aucun part à la spéculation. Lorsque cette fraude étoit découvert, le prévôt de Paris condamnoit les marchands à l'expulsion de la communauté de hanse." (Règlemens sur les Arts et Métiers de Paris. Introduction. Par G.-B. Depping, p. xxxiii.)

† Proceedings, Cleveland, 1896, p. 37.

‡ The Optical Journal, vol. ii, No. 8, p. 335.

Ibid., vol. ii, No. 10, pp. 391–393.

bered that certain oculists," says the president of the New York State Optical Society, disclosing the bitter spirit that animates these two classes of "philanthropists" and "benefactors," "have elected to assault even skilled opticians by calling them quacks, charlatans, and fiery-eyed ignoramuses, we are certainly justified in refuting their allegations in a more gentlemanly and professional way."* Finally came the smothered conflict between the "dispensing opticians" and the "refracting opticians," who, although united for relentless war on the oculists, have widely divergent notions as to the character and limits of their own professional skill.

The same belligerent spirit exists between the plumbers and kindred trades. "A practical plumber, one who is concerned about elevating his profession," says a report from Delaware, "finds it exceedingly difficult in the small towns to compete with the tinsmith and hardware men."† The same complaint comes from Kentucky. "Nearly all of the plumbing in the smaller towns," it says, is "done by tinners, hardware men, machinists, and even 'nigger' blacksmiths."‡ Could anything be more provocative of indignation and resistance in men possessed of a high spirit and noble aims? Afflicted as the feudal corporations were with illegitimate competition, they did not have to meet upon the field of honorable labor the ignoble rivalry of "niggers." The vice-president of the Oregon Association mentions as a particularly flagrant example of the unfair competition that the "honest plumber," one "concerned about elevating his profession," has to struggle against, a firm that advertises "Hardware, stoves, and ranges, sanitary plumbing, tin and sheet-iron work, groceries, provisions, and cord wood." "And still," he adds, as though recounting a miracle, but showing that honest work may be done without laws and ordinances, "these parties do a good job of plumbing."* Passing from the country to the city, where the evolution of industry has gone further and the lines that separate one trade or profession from another have become more distinct, the conflicts between plumbers and other occupations are more bitter and relentless.‖ A stone mason is not permitted to build a drain under a house nor connect it with the sewer. Without the risk of arrest and prosecution a steam or gas fitter can not put in a water or waste pipe. To the hardware man is denied

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* The Optical Journal, vol. ii, No. 4, p. 119.

† Proceedings, Cleveland, 1896, p. 52.

‡ Ibid., p. 58. * Ibid., p. 54.

‖ The recent quarrel between the plumbers and gasfitters in New York city, which at one time threatened very serious consequences, grew out of the absurd question, decided by President Seth Low, who was made arbitrator, as to which trade had the right to put in the thermostatic attachment to radiators.

the right to connect the range he has sold with the water system of his patron's house.*

Although this intolerable despotism continues to grow by what it feeds on, and its complete abatement is not likely to come soon, there are not wanting some faint signs of revolt. The hardware men of Buffalo, N. Y., have refused to submit to it, and are engaged in a hot fight against the tyrants of the wrench and soldering iron. † As already indicated, the opticians of the State are also in rebellion against the oculists, having discovered in the benevolent legislation of these "social reformers" an attempt to enslave them. "Let us," says the president of the State Optical Society just quoted, summoning his followers to arms and defending his course with an argument equally cogent against all other assaults on personal liberty, "concentrate with the fearless determination to throw off the yoke which some oculists are so determined to have us wear by relegating us to a position of abject dependence upon them, and thus exposing ourselves to the exercise of a power which might, in a moment of emergency, make perjurers of all who lack the fortitude to resist it." ‡

But futile as has been the attempt to create the honest and competent plumber and to make him a national blessing, the effort to find the honest and competent official to enforce legislation and to rescue the public from the dangers of imperfect work has not been less prolific of disappointment. When I say that the failure has been signal and inevitable, I do not express the opinion deduced from first principles nor from every experiment with the black art of the lawmaker since its first dicovery. I express only the honest and unpremeditated convictions that plumbers themselves have reached. Even Mr. Spencer has scarcely described more vividly and effectively the political entanglements, the industrial paralysis, and the moral enervation that follow the practice of this system of modern magic. "It does seem impossible," said a Syracuse delegate at a State convention of master plumbers, after listening to a melancholy tale of the neglect of

* So intolerant have some plumbers become that it has been proposed to pass "a law making it a criminal offense for a person to hang out a sign, handle tools, or construct any part of plumbing work." (Remarks of Mr. Hosford, of New York. Proceedings, Pittsburg, 1889, p. 105.) A less intolerant but equally absurd and despotic proposition is that of the Michigan dentists. In a State Convention last year they passed a resolution in approval of an act for the appointment of a State dental examiner, whose duty should be to inspect the teeth of all children, and enforce such regulations as might be necessary to preserve the molars and bicuspids of the public. (Chicago Times-Herald, June 16, 1896.)

† Buffalo Courier, November 12, 1896. As further proof of the unselfish spirit that animates the plumbers of Buffalo, it may be said that for the work of connecting a range with the water pipes they charge from eight to twelve dollars. The hardware men claim that it is worth only three or four dollars.

‡ The Optical Journal, vol. ii, No. 4, p. 120.

examining boards to do their duty, "to keep politics out of examining boards." * But the same trail is just as visible elsewhere. "You think it is the Board of Health," said an Albany delegate, showing how other officials have shirked their duty. "We have been there and made our complaint. They inspect the work brought to their office, they say. I have been to the corporation counsel and can not get any satisfaction. I have been to the district attorney and to the justice of the police court. They laugh at us." † This is the experience always had with the machinery invented to enforce the laws of any despot, be he French or American. The men that refuse to submit to them are too influential to be antagonized with impunity.

Even if public officials possessed the Spartan virtue of Boyleau, who, according to the Sire de Joinville, yielded to no influence "*de parente, ni d'amys, ni d'or, ni d'argent*"; ‡ even if they were to enforce the law with Draconian rigor, it could and would be evaded. "'There are many ways of killing a cat besides choking him with butter,'" said Mr. Firmin at the Philadelphia convention, "and the law may be obeyed, while it is at the same time practically evaded and violated. No matter," he added, speaking with a professional knowledge that a layman would not presume to question, "how impartial, honest, and competent an inspector may be, in the very nature of things there are one hundred and one ways of putting his eyes out." * Could some legislative genius discover a way to prevent this loss of sight, protection from incompetent or dishonest plumbers would still be impossible. "There are a great many things," said Mr. Edward Schuster, of St. Louis, at the same convention, "necessary to a first-class job, which do not come under his supervision and which he is not responsible for, and yet they are of so much importance that they can not be omitted." ‖ Of what use, then, is a plumbing law? Of what use also are inspectors?

Still, the bottom of the Pandora box, which "philanthropists" and "benefactors" have stuffed with the evils of such legislation, has not yet been reached. While it does not benefit the honest plumber, it often screens the dishonest one. Here again I do not trust to the conclusions drawn from the doctrine of *laissez-faire*, nor from the unsupported assertions of prejudice. My statements are none other than those of the master plumbers themselves. "Plumbers imagined," said Mr. Dent Yates at the Detroit convention, "that the strictest ordinances (a few of which would make the framers of the Rhode Island blue laws weep with

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* Unpublished Proceedings, Buffalo, 1894, p. 59.

† Ibid., pp. 55, 56.

‡ Biographie Universelle, vol. v, p. 436.

* Proceedings, Philadelphia, 1896, p. 91.

‖ Ibid., p. 94.

envy) would be a big bonanza. . . . But some of the self-same ordinances, designed to protect the good, conscientious plumber, have here and there acted as a screen for the quack plumber and fat for the ward bummer and the grog-shop politicians." * Is this not saying, as was once said to a French despot, that for every office he was pleased to make God was pleased to make a fool to fill it? With a touch of bitter disappointment over honest toil gone for naught, Mr. Firmin declared, in the essay quoted from already, that the plumbers that had "endeavored to be just to their fellow-men," that had "given their best thought" to "devising improved methods of practical sanitation," that "could point to the improved standard of plumbing as a part of their labors," had "not been rewarded in anything like a just ratio. . . . I might," he added in a tone of deeper disappointment, "even say in an everyday dollars-and-cents view," that they "have not directly benefited at all." †

The most serious evil remains to be mentioned, for it falls upon the very persons whose benefit is, in the eyes of the "philanthropists" and "benefactors," its sole justification. Instead of making them more alert to protect themselves from the dangers that assail them and to secure the services of the most expert to aid them in this difficult task, it creates in them a state of indifference. Conscious that benevolent statesmen have made laws to keep them from harm, they fancy that it is no longer needful for them to take thought of the morrow. Plumbers themselves, with all their ardent faith in legislation, have not been able to shut their eyes to this peril. More than once have the thoughtful among them called attention to "overconfidence on the part of the architect and the general public" in "the cure-all-ism of the plumbing law." "This danger is at once serious to the public and to ourselves as business men," said the Sanitary Committee at the Philadelphia convention. ‡ "We found," said Mr. Firmin, also, "that the public has come to rely to a dangerous degree upon plumbing laws. . . . The danger lies," he added, "in the fact that the public believe that all plumbers, by virtue of the law's operation, are compelled to produce equal and certain results, and that if they have a certain piece of work to be performed it will make no difference whether they give the job to Jones or Brown. . . . Therein they fall into error, injuring themselves, as well as the honest plumber. They remove the incentive to progression and honesty." The Sanitary Committee takes the same view in almost the same words. "There has arisen a belief," it says, "that now it is not necessary to use care in the choice of your

* Proceedings, Detroit, 1894, p. 169.

† Proceedings, Philadelphia, 1895, p. 91.

‡ Ibid., p. 43.

plumber, since he is by law compelled to comply with modern sanitary principles and mechanical arrangements. Never was a greater error committed by the public," with "far-reaching results for evil."* This, however, is only an expression of the truth that the public must, in spite of all supervision, look after itself.

But, like a nobler sentiment, faith in the efficacy of legislation for the cure of all social ills, including those from incompetent barbers and horseshoers, "springs eternal in the human breast." It is not enough that such a law as the plumbing law can not be enforced; that, even if it were enforced, it would not yield the benefits that its framers anticipate; that, instead of favoring the honest plumber, it favors the dishonest one, and enables the unscrupulous politician to bribe or coerce constituents; that, instead of promoting the interests of the public, it is a detriment to them, producing a false sense of security perilous to health—it is still proposed to follow to the death the same *ignis fatuus*. To be sure, the most advanced "philanthropists" and "benefactors" do not propose to enact more rigorous municipal regulations or more elaborate State laws. These have failed. But they propose to resort to the great panacea of periodic inspection and national legislation. Preparing the way for the exercise of the last hope of the apostles of benevolent despotism, the Sanitary Committee of the Philadelphia convention declared that "no matter how thorough and complete" a piece of plumbing may have been done, "Nature, assisted by use, abuse, and neglect, will render that which was perfect most imperfect."† It then proceeds to urge with fitting solemnity "the very great importance of legislative action looking to and providing for periodic expert examination of sanitary appliances." That is to say, since people can not be trusted to keep their plumbing in order, the State must, like a policeman, compel them to do so. "A system of laws emanating from Congress," says an authority quoted with approval by the same committee on another occasion, after pointing out, among other things, that "the laws enacted by State and local authorities are continually subject to change according to the whim of any petty politician who sees his self-aggrandizement

* Proceedings, Philadelphia, 1895, pp. 43, 44. "The committee did not believe, however, that national legislation on the subject was desirable. It said: 'In the nature of things, it is impossible to form laws which would be equally appropriate to all sections of the country; that which would be best suited to the needs of Michigan would prove most faulty for Louisiana. A system approaching perfection as applied to California would be ridiculous if applied to Maine' (p. 43). But, as shown in the text, this sensible view was repudiated by the committee in the following year. It was crushed under what Mr. Spencer has fitly characterized as the momentum of the socialistic movement."

† Ibid., p. 44.

in any movement that may please a portion of his constituency," "would obviate all such trouble. . . . Such laws would be enforced by the State and local boards of health, and, in case of their failure or neglect, such attention and assistance from the national powers should be given as the circumstances of the case may require."* That is to say, again, a defective principle inoperative on a small scale can be made a success on a large one. Although a despotic local law can not be enforced, a despotic national law will be scrupulously observed. If local officials can be blinded in "one hundred and one ways," national officials are subject to no such impairment of vision.

II.

But this is only a fresh illustration of the pathetic faith of the chronic invalid, ever on the search for a new pill or a new tonic. A change from one despotism to another, or from one set of officials to another, will not deliver society from the defects of human nature. Much less will that blessing come from the increase of despotism and the multiplication of officials. Such quackery has been tried from the dawn of Greek democracy down to the latest product of popular sovereignty—the Brazilian Republic. It has failed; it must inevitably fail. It violates a law of social development as immutable as the law of gravitation, one that punishes those that fail to heed it with equal certainty and severity. I refer to the law set forth by Mr. Spencer that the more peaceful and industrious a nation becomes, the less is its need of the restraints of either custom or legislation. But of this matchless induction of modern science the social reformers of to-day have no conception. They act upon the assumption that the world has made no headway in a thousand years; that men are still barbarians and require the shackles of an age of disorder; that there must be the official mechanism of an old French or Prussian despotism, which had no other use than to recruit and drill troops and to wring taxes from despised and impoverished toilers. But since the days of feudal chaos humanity, despite the obstacles thrown in its path by ignorance and interest, has gained ground. Men have outlived the rules and regulations of a military despotism. They do not pay homage to the occupant of a throne, surrounded by courtiers as intent on the plunder of subjects as soldiers on the plunder of enemies. Their allegiance is to another ruler, which, though less regal, is not less powerful; it is conscience, the embodied restraints that come of peace, sympathy, and culture.

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* Proceedings, Cleveland, 1896, p. 31.

If the obedience due this ruler of the modern industrial world is imperfect, the reason is not difficult to discover. It is because his reign has been brief, and human nature is still crude. Too many vestiges of countless ages of conflict cling to the brain of man. Too much misdirected effort is made to fit the institutions of murder and pillage to times of peace and industry. Obsolete as a battle axe or a coat of mail, they do not extinguish the traits inherited from savage ancestry; they only stimulate and perpetuate them. No matter whether they be tried under the despotism of a French feudal monarchy or under the popular sovereignty of the American Republic, the effect is identical. They engender the same greed, the same hypocrisy, the same deception, the same contention. No abridgment of liberty that philanthropists or statesmen may deem essential to the safety of modern civilization will permit them to realize their Utopian dream. The millennium lies in another direction—in the direction of greater liberty. As society becomes more and more complex, with wants so great and varied as to pass the knowledge of any benevolent despot ruling by divine right, or any group of despots ruling by virtue of universal suffrage, individuals must be allowed more and more to control their own destiny, and to take the consequences, good or bad. Whatever government they may need to direct their countless enterprises for the supply of those wants and for the regulation of their relations with one another and with the public, must not be the product of political selection, but of industrial selection; it must not be the choice of ward bummers and complaisant citizens that register the will of an unscrupulous and irresponsible demagogue, ambitious to exercise a power that decent people refuse him, but of the men that have staked their fortunes in business, whose success or failure is dependent upon the wisdom of their action. Not the least fit, but the most fit, will then administer the affairs of the world. With the continuance of peace and industry they will not be the greatest fools or knaves, now so often charged and unhappily so often proved, but the wisest and most upright. Civilization will not then go backward, as it now threatens to do, but it will go forward, as it did with the enlargement of liberty that has been the most splendid achievement of the last four centuries of thought and effort.

THE eager haste with which men of fixed notions are apt to rush to conclusions is portrayed rather than caricatured in Lord Houghton's version of the debate between Huxley and Bishop Samuel Wilberforce in the British Association in 1860, which Sir E. Grant Duff quotes in his Notes from a Diary. As the story is told, Mr. Huxley asserted that the blood of guinea pigs crystallizes in rhombohedrons. "Thereupon the bishop sprang to his feet and declared that 'such notions lead directly to atheism.'"

PRINCIPLES OF TAXATION.

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VII.—RULES OR MAXIMS ESSENTIAL TO AN ADMINISTRATION OF RIGHTFUL TAXATION UNDER A CONSTITUTIONAL OR FREE GOVERNMENT. PART II.

IN continuance of the discussion entered upon in the preceding part of this chapter, as to whether under a constitutional and free government, and in virtue also of the natural and inalienable rights of the people governed, a state has a lawful right to levy and expend taxes in furtherance of private interests, more especially by way of bounties, the following additional points may be worthy of consideration:

Probably no better exposition of the limitation on the exercise of the taxing power incumbent on a free government professing a regard for the rights of the people, and more especially on the Federal Government of the United States, under its Constitution, in respect to the granting of payment of bounties for the promotion of the private interests of any of its citizens, can be found than the following, accredited to Justice Thomas M. Cooley:

"It is not in the power of the state, in my opinion, under the name of a bounty, or under any other cover or subterfuge, to furnish the capital to set private parties up in any kind of business, or to subsidize their business after they have entered upon it. A bounty law of which this is the real nature, is void, whatever may be the pretense on which it may be enacted. The right to hold out pecuniary inducements to the faithful performance of public duty in dangerous or responsible positions stands upon a different footing altogether; nor have I any occasion to question the right to pay rewards for the destruction of wild beasts and other public pests, a provision of this character being a mere police regulation. But the discrimination by the state between different classes of occupations, and the favoring of one at the expense of the rest, whether that one be farming or banking, merchandising or milling, printing or railroading, is not legitimate legislation, and is an invasion of that equality of right and privilege which is a maxim in state government. When the door is once open to it there is no line at which we can stop and say with confidence that thus far we may go with safety and propriety, but no further.

"Every honest employment is honorable; it is beneficial to the public; it deserves encouragement. The more successful we can make it the more does it generally subserve the public good. But it is not the business of the state to make discriminations in favor of one class against another, or in favor of one employment against another. The state can have no favorites. Its business is to protect the industry of all, and give all the benefits of equal laws. It can not compel an unwilling minority to submit to taxation in order that it may keep upon its feet any business that can not stand alone."

A brief historical retrospect is here pertinent to this subject. The payment of bounties from the proceeds of taxation, or rather of exaction, is a relic of the commercial methods of the middle ages. They were, however, regarded as legitimate fiscal expedients for the encouragement of trade and domestic industries during the whole of the last (eighteenth) century; but since then, under the influence of a higher civilization and modern economic ideas, have been almost entirely discarded from the fiscal systems of the leading commercial nations until within a comparatively recent period, when they have been revived and made mainly applicable to the production and sale of a single one of the world's great commodities—namely, sugar;* and the history of this experience constitutes a most interesting and instructive chapter in economic history.

Although the practice of stimulating the production of beet-root sugar in Europe through high protective duties on imports and export bounties dates back to the first quarter of the century, the present complicated and curious state of affairs is really due to a method of taxing beet sugar by Germany which was adopted in 1869. The idea involved in this method was, in brief, to collect an excise or internal-revenue tax on all sugar produced, and give a bounty on so much of the domestic product as was exported or sold to the people of other countries. The other states of continental Europe, finding the markets of their own product of beet-root sugar everywhere supplanted by the German sugars, and their domestic manufacturers being thereby brought to the verge of ruin, made haste to follow the example of Germany, until the policy of Germany, France, Belgium, Holland, Austria, and Russia seems to have been to stimulate their domestic product of sugar to the greatest extent, and then enter into competition with each other to see which of them could sell cheapest to foreigners at the expense of their own people. The general result is, that the great beet-sugar industry of Europe has been established and is now conducted on what may be regarded as an artificial basis, and one not inaptly characterized as a most ingenious method for entailing money losses on the mass of the people of the countries above mentioned.

The immediate sequence of this policy has been an enormous increase in the beet-sugar product on the Continent of Europe—i. e., from 2,223,000 tons in 1885–'86 to nearly 5,000,000 (4,789,000) tons in 1895–'96—with such a reduction in price that the whole sugar industry of Europe is seriously depressed, with a general

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* The policy of payment of bounties for the encouragement of shipping and of ship-building enterprise has also, to a limited extent, been established, more especially by the two Governments of France and Italy.

complaint on the part of producers that the amount received by them does not cover the cost of production. Under such a condition of affairs, the German Parliament (Reichstag), in May, 1896, accepting a popular declaration that "sugar was the last and only agricultural product in which there remained any profit for the German farmer, and that whatever skillful legislation could do to preserve and protect that industry should in justice to the suffering landowners be given a prompt and thorough trial," passed an act increasing the bounty on the export of sugars to an extent assumed to be sufficient "to enable German exporters to compete against all comers in foreign markets"; advancing the import duty on sugars to a prohibitory degree; and fixing an internal-revenue tax on sugars to such an extent as to yield a net income to the state in excess of its disbursements on account of bounties on exports. The effects of the new statute have now become apparent and ominous. The foreign sugar market has responded to the increased bounty export by a proportionate decline in price; and a movement now finds favor to petition the Reichstag to make certain amendments in the existing statute so as to restrict instead of stimulating production, and to invite international negotiations for the gradual abolition of all export bounties, which have been proved to be simply a burden on the treasury, which pays them for the benefit of non-producing foreign countries.

The present burden which the sugar-bounty system entails upon the taxpayers of Europe is estimated at about $25,000,000 per annum, while the excise tax on sugar in Germany, France, and Austria is said to amount to $100,000,000 per annum. On the sugar consumed by the people of the continental nations of Europe which have adopted the bounty policy there is no bounty, but on the contrary an excise tax; the result of which legislation is to make exported sugars very cheap and home consumption abnormally dear. This is demonstrated by reference to the statistics of the comparative consumption of different countries. Thus in England, whose policy since 1874 has been to give her people sugar free of taxation, the *per capita* consumption has risen from fifty-six pounds in that year to eighty-six pounds in 1896; while the saving to the British people from the reduction of the cost of this one item of their living has been estimated to be at least £6,000,000 ($30,000,000) per annum. The great reduction in the price of sugar has also given a remarkable impetus to the British industry of manufacturing sweets, in the form of confectionery, preserves, jams, marmalades, etc., which last to a considerable extent have undoubtedly supplanted the use of butter. The present annual average consumption of sugar in Germany is reported to be about twenty-seven pounds *per capita*. In France

the declining consumption of sugar has been made the subject of recent debate in the Chamber of Deputies, where the question was pertinently asked by one of the deputies (M. Méry) if the object of the existing governmental policy in respect to sugar "was mainly to produce it or to have and enjoy it." The Agricultural Society of France has also recently unanimously indorsed a demand of the French sugar makers and refiners that the Government should increase the present bounty on the export of sugar to an extent equivalent to the combined or aggregate bounties allowed in Austria and Germany.

So much, then, for nearly half a century's experience on the part of the leading continental nations of Europe in attempting to regulate the production, price, and consumption of sugar through a system of bounties.

Practical experience in respect to the employment of bounties also leads to a deduction, which may be almost regarded in the nature of a principle, that when bounties are employed for the promotion of some public good, the object sought eventually becomes subordinate to the opportunity which an unnatural and unprincipled perversion of the bounty provisions affords for the promotion of private rather than public interests. The following illustrations, though somewhat comical in their nature, serve to sustain this proposition:

In the early years of the present century the State of Connecticut, having in view the promotion of its agricultural interests, offered a premium on the destruction of the crow; to be paid on the production of the head of the bird to the proper authorities. Thereupon the sons of the farmers, desirous of earning a little money, then much more difficult to obtain than at present, diligently searched the woods for the nests of crows, from which at the proper time the eggs were transferred to sitting hens, by whom they were hatched and the resulting offspring brought up until their heads became available for presentation and procurement of the bounty. A summary of the general results of such experience would be somewhat as follows: First, a perversion of the legitimate industry of the hen; second, an elementary lesson for young persons in perpetrating frauds against the State; third, an impairment of the agency of a bird, whose habits have been proved by subsequent scientific investigations to be beneficial rather than detrimental to the interests of the farmers. Again, in the early history of one of the Northwestern States of the Federal Union a bounty was offered, at the request of the farmers, for the heads of little burrowing animals known as "gophers," which attracted little attention till the experience of several years showed that the disbursements of the State on this account had become abnormal and were rapidly increasing. In-

vestigation then proved that the raising of gophers by citizens of the State for the procurement of bounties had become a regular industry. A like experience in British India is also worthy of note. Some years since the Government, with a view of arresting the mortality among its native population from the bites of poisonous serpents, offered a bounty on their proved destruction; when it was found that for the sake of obtaining the bounties the cultivation of the "cobra" and other like snakes had been actually entered upon.

Third. *The sphere of taxation should be limited to persons, property, and business exclusively within the territorial jurisdiction of the taxing power.* It would seem to be in the nature of a self-evident proposition, although in fact it is by no means so regarded, that the power of every state or government to tax must be exclusively limited to subjects within its territory and legal jurisdiction. "*All subjects,*" says Chief-Justice Marshall, in giving the opinion of the Supreme Court in the case of McCullough *vs.* Maryland (4 Wheaton, 431), "*over which the sovereign power of the state extends are objects of taxation; but those over which it does not extend are, on the soundest principles, exempt from taxation.*" And again, "the sovereign power of the state extends to everything *which exists by its own authority* or *is introduced by its permission.*" "Every nation," says Wheaton, "possesses and exercises exclusive sovereignty and jurisdiction throughout the full extent of its territory. It follows, from this principle, that the laws of every state control, of right, all the real and personal property within its territory. The second general principle is, that no state can, by its laws, directly affect, bind, or regulate property beyond its own territory. This is a consequence of the first general principle; a different system, which would recognize in each state the power of regulating persons or things beyond its territory, would exclude the equality of rights among different states, and the exclusive sovereignty which belongs to each of them." (Wheaton's International Law, chap. ii, § 2; Fœlix International Prisé, §§ 9 and 10.) And in a decision of more recent date (State Tax on Foreign-held Bonds, 15 Wallace, 306, 328), the United States Supreme Court said: "The power of taxation, however vast in its character and searching in its extent, is necessarily limited to subjects *within the jurisdiction of the state. Property lying beyond the jurisdiction of the state is not a subject upon which her taxing power can be legitimately exercised.* Indeed, it would seem that no adjudication should be necessary to establish so obvious a proposition."

The principle under consideration has also been made the subject of adjudication by the Uuited States Supreme Court in a case of historic as well as of legal and economic interest. In Septem-

ber, 1814, the country being then at war with Great Britain, the town of Castine, in Maine, was captured by the British forces, and remained in their exclusive possession until after the ratification of peace in 1815. During this period the British Government exercised all civil and military authority over the place, established a custom house and allowed merchandise to be imported, some of which remained in Castine after it was evacuated by the enemy. On the re-establishment of the authority of the United States, the American collector of customs for the district, claiming a right on the part of the United States to Federal duties on the goods in question, demanded payment of the same from the owners or importers; and, the claim being resisted, the case went up to the United States Supreme Court, which with complete unanimity gave judgment, through Justice Story, for the owners or importers in the following language:

"We are all of the opinion that the claim for duties can not be sustained. By the conquest and military occupation of Castine, the enemy acquired that firm possession which enabled him to exercise the fullest rights of sovereignty over that place. The sovereignty of the United States was suspended, and its laws could no longer be enforced there, or be obligatory on the inhabitants who remained there and submitted to the conquerors. By the surrender the inhabitants passed under a temporary allegiance to the British Government, and were bound by such laws and such only as it chose to impose. From the nature of the case, no other laws could be obligatory on them; *for where there is no protection or allegiance, or sovereignty, there can be no claim to obedience.*"

Taxes, therefore, are necessarily the creation of each state, and no self-respecting Government ever permits any other Government to interfere with its tax laws or their execution, and a toleration of such interference in any degree presupposes dependence, subjection, or absence of independence. An obvious co-relation of this proposition, and also a matter of fact, is that a violation of the tax or revenue laws of one country has never been regarded as an offense or crime in any other country; and the English courts have held that contracts to evade the customs laws of a foreign country are not illegal. Hence, also, offenders in this respect are never taken into account in extradition treaties between different nations and their governments. Some years ago a United States district attorney in New York procured through the Department of State at Washington the extradition of a person from England on the charge of forgery. On his arraignment before a United States court it transpired that the offense committed was the manufacture and use of fraudulent invoices, to which forged or fictitious names had been attached, for the purpose of evading the payment of United States customs

or taxes on certain imports; and that the intent of the prosecution was punishment, not for forgery in the ordinary sense of the term, but for smuggling, for which latter offense there was no precedent that extradition had ever been granted by any country. The attention of the British Government having been called to the case, a request was preferred by it to the authorities in Washington that the trial of the accused should be discontinued, on the ground that a fugitive from justice, when surrendered by a country in which he had sought refuge, should not be tried for any offense other than the one specified in the extradition demand, and for which extradition was granted. Compliance with the request being refused, although as a matter of fact the trial was discontinued, the British Government took occasion, when extradition was next demanded of her by the United States—which happened to be the case of a former well-known citizen of Boston who had committed forgery in the sense that constitutes a crime in all countries—to refuse it, although the offender had in the first instance been arrested in England and was in custody; and for many years subsequent and for reasons above given there was no extradition in force between the United States and Great Britain and her colonies, with the result of making Canada an *Alsatia*, or place of safe refuge, for all criminals of the former country.

All, therefore, that any government can legitimately ask of another government in respect to taxation is, that its subjects or citizens residing in such foreign state shall not be there discriminated against because they are foreigners; but shall be treated in exactly the same manner as the subjects or citizens of the taxing power and their property are treated—no better and no worse. If foreigners feel aggrieved, they must first exhaust all the remedies against unjust taxation provided by the institutions of the taxing country; as foreign importers, for example, aggrieved by rulings or appraisements at the custom houses of any country, must first appeal for redress to the courts of such country. A recent event of great economic and legal importance is also worthy of narration and consideration in this connection.

A board of appraisers and assessors charged with the duty of assessing, for the purpose of taxation, the property in Ohio of telegraph, telephone, and express companies, discharged the duties incumbent upon it—taking an express company for example—in the following manner: *First*, by determining the value and liability to taxation of the real estate of the company situated in Ohio; *second*, the personal property, including moneys and credits, owned by the company in Ohio, and the value thereof; *third*, the gross receipts during the taxing year of the company in Ohio, from whatever sources derived. It was conceded that the

returns made by the company to the above officials were correct, and that the aggregate value of the items included in such returns liable to taxation in 1895—the same as other like property in the State—was $42,065. The board of appraisers and assessors added, however, to this amount the sum of $491,030, making the aggregate of the tax liability of the express company $533,095; and based their action not on any belief or pretense that any considerable amount of real or personal property within the territorial jurisdiction of the State had been discovered which had hitherto escaped taxation, but that sources of reported value which were entirely outside of the territory and beyond the jurisdiction of the State of Ohio—when they constituted a part of the value of the capital or franchise of a corporation located and established in some other State for the purpose of carrying on business, and that business "interstate commerce" entirely within the control of the Federal Government—might be added to the intrinsic value of property within the State; thereby assessing not only property *within* the State of Ohio, but a proportion also of all property situated *without* its territorial boundaries. The question involved was therefore the constitutionality of extra-territorial taxation; and the case, after consideration by State and United States Circuit Courts, was finally brought before the United States Supreme Court. Here, notwithstanding the citation of numerous former opinions and judgments of the court wholly adverse to the constitutionality of the principle on which was based the assumption and action of the State of Ohio, the court by a majority of one held to a contrary view; and gave judgment in support of the State assessments on the express company. It is clear, therefore, that the State of Ohio has been justified, for the time being, in an attempt to tax something that it calls property, but which is neither tangible nor visible; that has no intrinsic or essentially inherent value; and which procedure, if generally accepted and put in practice by other States, would antagonize all formerly accepted theories and legal decisions in respect to extra-territorial taxation, and ultimately destroy all interstate commerce between the several States of the Federal Union.

AN IMPLIED BUT FUNDAMENTAL RECIPROCAL OF TAXATION. —Notwithstanding the absence of any warrant for assuming that there was ever any real or implied contract, whereby a State in its beginning or development agreed to give a certain amount of protection to life and property in return for an equivalent in money, goods, or services of its citizens—an assumption which has been characterized as the "commercial theory of taxation" *—

* "The right of a state to take the citizen's property must be put on higher ground if it is to stand on perfectly safe ground. Of course, such higher ground is not to be found

it is nevertheless true that the "co-relative" or "reciprocal" of taxation is protection; or, in other words, according to the political theory of our governments, national and State, and in fact of every government claiming the title to be *free*, taxes may be legitimately assumed to be the compensation which persons and property pay the State for protection. This assumption, it is believed, has been indorsed and accepted by every writer of repute on economic subjects who has discussed taxation from the time of Montesquieu down to a very recent period;* and in the repeated instances in which this matter has come before the courts for adjudication, the highest judicial authorities have uniformly given judgment or expressed opinions to the same effect. In confirmation of these statements the following citations are submitted:

"Where there is no protection," said Judge Story (in the case of the United States *vs.* Rice, 4 Wheaton, 276), "there can be no claim to allegiance or obedience." Again the same eminent authority (in the case of Miles *vs.* Duryea, Cranch, 481) thus strongly expresses himself: "It is an eternal principle of justice that jurisdiction can not be justly exercised by a State over property that is not within reach of its process—that is, property which it can not protect."

"*Taxes are a portion which each individual gives of his prop-*

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in the pretense that the right in question is the simple right of might; that the ruling power, whether monarch or majority, is physically able to take and apply as it chooses all that the individuals ruled over called their own; and that because it can, it morally may, take whatever part it thinks fit. With simple ethics the leviers of taxes, whenever they are a distinct class, are wont to content themselves. But whatever countenance they have received from such moral philosophers as venerate successful force, the principle will hardly serve those who study the matter as taxpayers."—*Theodore Bacon.*

* "The philosophy of our plan of voluntary political association is, that all individuals, and all the values within a community, shall aggregate into one mass all the power which they separately contain, which sum total shall constitute a sovereignty of the whole. This sovereignty—the soul of the State, which can not be impaired and the State survive—reflects back upon its constituents, in detail, all that it has received from them. What it receives, and what it returns, is of two kinds, as to both source and object, viz., individual service *to* the Government, and protection to the individual *from* it. Thus, in his individual capacity, a man is bound to perform military service, and the State, by the military arm, is bound to protect him from invasion. He is bound to do jury duty, and the authorities are bound, upon his demand, to provide him a jury. He is bound to aid the sheriff, and the sheriff is bound to execute process in his favor by *posse comitatus*, if necessary. These personal services correspond to those which in feudal times the mesne lord, holding a frank tenement, owed the lord paramount. They can not be compounded for, for their value consists in their being rendered in kind. *Their performance is the only price which the citizen pays for his citizenship.* The terms are not only consistent and harmonious with our general scheme of government, but are highly politic. To all political privileges we admit each one by virtue of his being a man, free born, and of lawful age; we ask him nothing concerning his property, unless his property asks something from us."—*Lowrey, Argument, New York Assembly, 1862.*

erty, in order to secure and have the perfect enjoyment of the remainder. Governments are established for the protection of persons and property within the limits of the state, *and taxes are levied to enable the government to afford and give such protection.* They are the price and consideration of the protection afforded." (Ingersol, J., Circuit Court of the United States, Duer *vs.* Small.)

"There is nothing poetic about tax laws. *When they find property, they claim a contribution for its protection.*" (Lowrie, Chief Justice, Tinley *vs.* The City, etc., 32 Penn., 381.)

Montesquieu, writing with the monarchical institutions of France mainly or solely in view, discusses this subject in his Spirit of Laws (book xxxi, chap. i), as follows: "The public revenues are a portion that each subject gives of his property, *in order to secure or enjoy the remainder.*"

"The right to tax an individual results from the general protection afforded to himself and his property."—*Vattel, Law of Nations, book i, chap. xx.*

"Property and law (i. e., government or the state) are born together and die together. Before laws were made, there was no property; take away laws, and property ceases."—*Bentham, Theory of Legislation.*

The principle here involved is also clearly and succinctly further expressed in the following citations:

"Taxation" is, in any view, taking private property for public use, and it can not be so taken without an equivalent, both as to the Government or the citizens. It is not competent to convert private property to public use by way of taxation, and without compensation, any more than by any other mode.

Taxation (if anything in the nature of principle is assumed as its basis) therefore implies that the government imposing it will return an equivalent. But to return an equivalent in the form that was taken, namely, money, would be stultification. The only equivalent that a government can return, and the only one, in truth, that justifies taxation, is in the nature of a guarantee that the person, property, or business on which the tax is imposed shall have all the rights which the civilization of the state represents, or, in other words, "protection."—*Redfield.*

"If it were practicable to do so," says Justice Cooley, "the taxes levied by any government ought to be apportioned among the people according to the benefit which each receives from the protection the government affords him. This is upon the assumption, never wholly true in point of fact, but sufficiently near the truth for the practical operations of government, that the benefit received from the government is in proportion to the property held or the revenues enjoyed under its protection."—*Cooley, On Taxation, pp. 14-17.*

Notwithstanding this preponderance of opinion, argument, and legal decisions in favor of the correlation of taxation and

protection, the truth of this assumption has been called in question in recent years, and even wholly denied by some economic and legal authorities. Thus, in most of the States of the Federal Union (but not in other countries), sovereignty in respect to taxation is assumed, or enacted to embrace "goods, chattels, money, and effects, *wherever they are;* ships, public stocks and securities, stocks in turnpikes, bridges, and moneyed corporations, *within or without the State*"; and where the administrators of the law tax *residents* for personal property, even of a visible, tangible character, having a *situs* in another State or country; and, by another irreconcilable rule, tax *non-residents* for all of their personal property having a *situs* within the State. (Massachusetts Statutes.)

Such antagonism would seem to be wholly due to an inadequate comprehension of the subject. It is assumed, for example, that there can be no necessary reciprocity of the nature indicated between the State and the subjects of taxation, because, in the case of subjects—persons, property, and business—upon which no tax is levied, there can be no correlation, and therefore no claim whatever for protection; and in illustration and support of this proposition it is pointed out that churches and other public institutions, specifically exempt from taxation, need and receive as much protection from the State as structures used for dwellings and stores, and that tramps, who have nothing to pay with, are equally entitled to invoke and use the power of the State for protection as those who are taxed for millions. "So also the business that is not taxed at all, it is said, can no more be plundered with impunity than that which is taxed the heaviest."* The error in all this reasoning is fundamental, and arises from a failure to comprehend that in every civilized state every person or thing is taxed, either directly or indirectly, by the diffusion of taxes, and that it is not possible to name anything in such a state that is exempt from taxation; that the primary purpose for which the state exists is to afford protection to persons and property; that it—the state—practically ceases to exist when it is unwilling or unable to afford such protection; and that, even if willing, it could not protect, except through the ability that comes to it through the possession of the power and the exercise of taxation.

Fourth. *Taxes should be reasonable, regular, and not arbitrary as respects method, time, and place of assessment and payment, and, above all, proportional.*

The justice and the necessity of these conditions as essentials of a true system of taxation ought to command universal assent

* The claim or argument in defense of extra-territorial taxation will be more fully considered hereafter.

without argument. Adam Smith held to the opinion, "founded," as he says, "on the experience of all nations, that the certainty of what each individual ought to pay is, in taxation, of so great importance that a very considerable degree of inequality is not near so great an evil as a small degree of uncertainty." The evil of uncertainty does not, however, often characterize the tax systems of the United States, except in the case of taxation by the Federal Government of imports, when rates (customs) are sometimes held for considerable periods in abeyance by reason of political antagonisms of legislators. One of the most remarkable example of this occurred during the months from December, 1893, to August, 1894, when the uncertainty as to the prospective rates on imported merchandise occasioned great stagnation of business in the United States, with inevitable great contingent losses. Another even more striking illustration of the evils of uncertainty in taxation is to be found in the recent (1897) proposition to subject merchandise, imported in strict conformity with established laws and rates at the time of importation, to the retroactive incidence of increased taxes, not certain but prospective in respect to rates, and not enacted or embodied in the form of statute laws. Such action is in the nature of an arbitrary fine or penalty, and not taxation, and probably does not find a parallel in the history of any civilized nation, and would not now be tolerated in any of the most despotic governments of Europe.

The term *proportional*, which is largely used in constitutional provisions and in statutes relating to taxation, has, however, a meaning so much broader and of such greater significance than is generally attributed to it by law-makers and even law interpreters, that it is worth while to institute an inquiry and endeavor to understand clearly what it does mean. Scientifically considered, it means *the making of the burden of taxation equal upon all subjects of immediate competition.* This principle is one of the prime essentials of taxation, and when it is violated the act of taking, or the enforced contribution, is not entitled to be considered taxation, but becomes at once an arbitrary spoliation or confiscation. Thus, to illustrate: Suppose it were proposed to tax the stock in trade of red-haired men five per cent, and those of red-nosed men ten per cent; or, as was provided in the income-tax law enacted by the Congress of the United States of 1894, which exempted incomes below four thousand dollars per annum from taxation and taxed all above that sum two per cent; or to do as actually once was done in England, under an income-tax law enacted in 1691, tax Catholics at rates double those imposed on Protestants; it seems clear that such transactions could not involve any principle or be regarded in any other light than the mere arbitrary and despotic exercise of power; or the making of

the possession of a red nose or red hair, or the result of enterprise, skill, economy, or the fortuitous circumstance of birth or belief, the occasion for inflicting a penalty. Yet this was what substantially was done in the middle ages, when nobles were exempt from taxation because they were nobles, and the common people were taxed because they were villains or bondmen; when Jews were assessed because they were not Christians, and Catholics because they were not Protestants.

It would seem to be clear, therefore, that a tax that is not levied proportionally or, what is the same thing, equally and uniformly upon all subjects *in the same field of competition*—as, for example, upon all persons engaged in the same business or profession, or upon all property of the same kind and all profit or income (less exemptions in the nature of charities) in the same ratio—is a discriminating exaction, without claim to either justice or equality, inasmuch as to the same extent that some are favored by the discrimination others are inevitably plundered or crushed. It is also well to remember that when the term "uniformity" in respect to taxation is used, as it often is, in the place of "proportionality," the meaning is essentially the same; and that uniformity of taxation does not consist in the payment of the same amount by each taxpayer, but that the proportion of the value of each particular class or subject which each person pays in taxation to the state shall be everywhere the same.

In the soundings which have been made at great depths in the ocean for telegraphic or other purposes, the sounding line has not infrequently brought up from the bottom small chambered shells or other minute animals of exquisite organization and structure; and the question naturally arises, How can these minute organisms live and flourish under the enormous pressure that in some instances must be exerted upon them of at least three tons to the square inch? The explanation is to be found in the circumstance that the pressure is everywhere equalized, being as much from within outward as from without inward, and thus an equilibrium is maintained, under which development goes on and existence is made possible; and it is in preserving this equilibrium, this equalization of pressure, that constitutes the very essence of correct taxation.*

Another point worthy of attention in connection with this subject is, that forms of taxation which were not authorized with any purpose of making them unequal in their incidence or burden, not infrequently (as is especially the case in the United States) become so by reason of extraneous circumstance; inasmuch as every tax which popular sentiment, year after year, will not allow

* Speech of Mr. Lowe, Chancellor of the British Exchequer, afterward Lord Sherbrooke.

to be equally enforced, is, to the extent that it is enforced, a discriminating tax of the most unjust and unequal character. Under the internal revenue laws of the United States as they existed not many years ago, there was a very striking example of this character in the case of the tax on matches, to which more particular reference will be made hereafter, and one worthy of notice still exists, in the case of the tax on negotiable securities (or instruments)—as railroad and other corporate bonds—which the laws of every State in the Federal Union make subject to taxation; inasmuch as it is notorious that such taxes are not paid by the great majority of the citizens who own such securities, but are paid as a rule by guardians, trustees, and executors, who are obliged to inventory them in probate offices; with the result that widows, orphans, and minors are plundered and crushed; while those who evade the tax, through the utter inability of the State to collect it, are rewarded for their evasion in an increased rate of interest. Uniformity or proportionality in taxation is, therefore, one of the fundamental principles of every free and just government; and the safety of all tax-payers against the grossest abuses demands that in taxing any class or locality the principle of equality of rate should be kept sacred and inviolate.

The Constitution of the United States requires that "all duties, imposts, and excises shall be uniform throughout the United States"; and the question as to what constitutes uniformity of taxation under this provision has repeatedly come before the courts—Federal and State—for the purpose of definition, and so has become invested with a degree of historical interest. A natural inference, at first thought, would be, that under this provision of the Federal Constitution all property subject to taxation must necessarily be taxed at the same rate or ratio—that is, if horses, wagons, and land are taxed, then the same per cent of value must be assessed upon the horses and wagons as upon the land; and if some eight hundred per cent is assessed upon distilled spirits—whisky—(as is the case in the United States at the present time) every other commodity from which it was proposed to raise revenue ought to be taxed in the same proportion. In like manner under the customs, all imports—liquors and pig iron, for example—would have to be subjected to one rate of duty. This difficulty, so far as the Federal Government is concerned, has been obviated by an assumption, which the courts have sustained, that a tax "is uniform within the meaning of the constitutional requirement if it is made to bear the same percentage over all the United States"—that is, it must be uniform as regards any particular article in all places; that whisky or any other commodity, for example, shall not be subjected *to Federal taxation* at one rate in one State and at a different rate in another State, but that differ-

ent articles may be subjected to different rates, provided they are uniform as between different places and different States; as it obviously "could not have been the intent of the framers of the Constitution that the Government in raising its revenues should not be allowed to discriminate in respect to articles which it desired to tax." *

In the case of the several States of the Federal Union, to which the Federal constitutional requirement in respect to uniformity of taxation does not apply, the same question—i. e., as to what constitutes uniformity—has been also a troublesome one, but different in its manifestation. The provisions relating to taxation in the Constitutions of these several States generally start with the idea, expressed or implied, that taxes must be uniform; and a strict construction of this language in a tax statute, operative in only one State, and where the Federal limitation of *uniformity* as respects place does not apply, might be construed as restraining the authorities of a State from imposing any different rate of taxation on the manufacture or sale of liquors and the manufacture and sale of other merchandise, or on the land and the business of the agriculturist. These difficulties in the way of construction have, however, been largely obviated by recognizing that when in the statute of a State the words "taxes must be uniform" are used, the word "uniform" does not mean, as in the Federal Constitution, uniformity as to "place," but uniformity "with regard to the subject of the tax"; an interpretation in full conformity with the principle before enunciated, that uniformity of taxation consists in the making of the burden of taxation equal upon all subjects which are in the same field or sphere of competition; or, as has been also expressed by Justice (S. F.) Miller, "different articles may be taxed at different amounts, provided the rate is uniform on the same class everywhere, with all people and at all times. Take, for instance, the case of a license: if everybody in any particular class is required to pay a certain license—if all lawyers are taxed twenty-five dollars a year, all merchants one hundred dollars, and all saloonkeepers two hundred dollars—then the license taxation is uniform, because it imposes the same burdens upon every man of the same class, who comes within a circle of well-defined limits. . . . This interpretation," he adds, "may be a little strained, but probably it has arisen from the necessity of enabling the Legislatures to levy taxes according to common sense, if not altogether with regard to strict uniformity." †

The opinions expressed by the State courts of the United States when this question of uniformity of taxation has been

* Lectures on the Constitution of the United States, Justice Miller, pp. 240, 241.

† Miller (Justice S. F.), ibid.

practically brought before them, is indicated by reference to the following decisions:

The Constitution of the State of Pennsylvania provides (Article IX, section 1) that "all taxes shall be uniform upon the same class of subjects within the territorial limits of the authority levying the tax, and shall be levied and collected under general laws." In June, 1885, an act was passed by the Legislature imposing a tax of three mills on the dollar on mortgages, moneys loaned or invested in other States, money capital in the hands of individual citizens, and other classes of property. The act did not extend to corporations, which were taxed at a similar, in some cases at a higher rate, under a statute of 1879. The act of 1885 was opposed on the ground that it violated the constitutional rule of uniformity, but it was declared valid by the Supreme Court of the State, which held that substantial uniformity had been obtained.

A decision in New Jersey turned upon a constitutional provision that "property shall be assessed for taxes under general laws and by uniform rules, according to its true value." In 1884 the Legislature of the State passed an "act for the taxation of railroads and canals," which imposed a tax upon the lands and tangible property used by railroad and canal companies and their franchises, and touching no other property. The constitutionality of this law was questioned by most of the leading companies, but was affirmed by the State Court of Errors and Appeals, which held that as the law was a general one, framed in general terms and restricted to no locality, it operated equally upon a whole class of property, whose characteristics enabled it to be dealt with separately. The court further declared, that as a previous act had secured the companies against being required to pay more than their full share of tax, a substantial uniformity was thus secured.

These and other like decisions of the State courts of the United States show that in order to sustain a tax law under the requirement of generality or uniformity it is not necessary that all property should be taxed, and that a State has the right to select property for taxation at its discretion. Of course, discrimination may result from the exercise by the State of the power of dividing the objects of taxation into classes, but while persons of the same class and property of the same kind are subjected to an equal burden, the constitutional requirements as to uniformity seem to be satisfied.

The fourteenth amendment of the Constitution of the United States, which prohibits any State from depriving any person of property "without due process of law," is also in conformity with the principle enunciated in the above citations; for taxation without jurisdiction, and therefore without the possibility of the correlative return of any protection as compensation, would obviously be an arbitrary exaction and not due process of law. But if property is otherwise (than by taxation) taken by the Government (as by the so-called law of "eminent domain"), full and fair pecuniary return must be made for its value. This is a prin-

ciple as old at least as constitutional government, and is so important that it is incorporated in the fundamental law of every State in the Federal Union. Article V of the Constitution of the United States also provides that private property shall not be taken for public use without due compensation. It is clear, therefore, that there must be a line between the taking of private property for public use by the law of eminent domain and by taxation. But how can that line be drawn except by the rule that rightful taxation means uniformity of burden on competing vocations and competing property? The following decision by the Supreme Court of New Jersey is clearly in conformity with this conclusion: "A tax," it said, "upon the persons or property of A, B, and C individually, whether designated by name or in any other way, which is in excess of an equal apportionment among the persons or property of the class of persons or kind of property subject to taxation, is, to the extent of such excess, the taking of private property for a public use without compensation. The process is one of confiscation and not taxation." (Township Committee of Reading, 35 N. J., p. 66, 1872.)

Fifth. *Taxation should not be employed as an agency or for the purpose of enforcing morality, or as an instrumentality for correction or punishment.*

The punitive or moral idea has probably always entered to some extent as an element in all those taxes which have been levied on luxuries, and more especially on all those forms of luxury which are regarded as frivolous or as mere insignia of wealth and title, such as hair powder, wigs, coats of arms, carriages, etc. But when a government assumes to inquire what are the articles the consumption of which is prejudicial to the interests and well-being of its people, and then embodies the results of such inquiries into its measures of revenue; so that while providing means for the support of the state it also prescribes how the citizen ought to live, dress, eat, or drink, the result is always ineffectual for purposes of revenue, and far more so for the promotion of morality. Examples illustrative and confirmatory of these conclusions are so numerous as to make a selection of them not a little difficult. The following have been cited by the late Sir Morton Peto: "A tax on dice in Great Britain, repealed in 1862, had the ludicrous result of producing for many years a revenue of five shillings per annum from a license of thirty to forty pounds a year on the business of manufacturing them. Another provision of law was that every person having dice unstamped by the revenue officials in his possession was liable to the penalty of five pounds for each pair! But stamped dice could not be obtained. Every one who wanted dice, even cabinet ministers and

revenue officials, purchased square pieces of ivory for a few pence and marked them for themselves. As regards packs of cards, the regulations imposed by a number of complicated acts of Parliament were so stringent that legally cards could scarcely be made or sold. Nevertheless for many years cards were hawked about the streets unstamped and without a license; and the manufacture of cards for exportation was so flourishing that nearly half a million packs were estimated to be surreptitiously made for exportation at the time the obnoxious taxes were repealed."

Sixth. *No tax should be levied the character and extent of which offer, as human nature is generally constituted, a greater inducement to the taxpayer to evade rather than pay.*

The justification and wisdom of the above maxim find support in a lesser degree from argument than from experience, although the deductions from abstract reasoning ought alone to constitute its sufficient indorsement. It has been pointed out by Herbert Spencer that ideal men are possible only in an ideal state; and, conversely, that a perfect social state is possible only when every unit has achieved perfection. As this condition has not been attained, and until the "millennium" arrives is not likely to be, the inference is legitimate that a large proportion of mankind are not "decently honest," inasmuch as in every variety of business where opportunity for the perpetration of fraud exists, much labor is expended in guarding against dishonesty. This is specially exemplified in the case of railroads, "where tickets have to be dated, punched, and carefully collected to prevent their being used again by the masses."

But it is in matters of taxation that the largest amount of irrefutable evidence is to be found in support of the above maxim. Thus in the case of smuggling or the evasion of duties on imports, the experience of all governments and of almost all countries is to the effect, that when sufficient inducement in the way of gain from a violation of the law is offered, such statute can not be executed even when penalties as severe as death have been made contingent on individual arrest and conviction. But it has been reserved for that nation whose people claim to be the most law-abiding and intelligent, to furnish the most confirmatory evidence on this subject—namely, the United States—the Congress of which in 1865 imposed a tax on distilled spirits amounting to more than fifteen hundred per cent on the then average prime cost of production. The result was, that the Government was only able in 1868 to collect the tax on less than seven million gallons out of an annual product of certainly not less than fifty million gallons; which last, sold as it undoubtedly was at the current market price (tax included), left to the credit of popular corruption at least $80,000,000.

The United States is confessedly one of the most powerful of nations and governments, but its entire military force can not crush the illicit traffic in refined opium, under a temptation of the realization of six dollars contingent on every pound of this commodity that is successfully smuggled into the country.

THE BUBONIC PLAGUE.

By VICTOR C. VAUGHAN,
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THOSE twin monsters of human misery, Famine and Disease, are now holding high carnival in India. Death follows in their wake and gathers in a rich harvest. Appeals to the charitable of the world are being made, and the civilized nations of Europe and America are looking apprehensively toward the East. The great plague, which has confined its ravages for the most part to certain limited districts of Asia for the past two hundred years, seems to have grown strong enough to threaten to take a journey abroad. The black death has unfurled its banner in the face of modern civilization. For a period of more than a thousand years this disease once held dominion over Europe. The story of the horrors of the fourteenth and seventeenth centuries has seemed a history of a past so remote that it has been nearly forgotten save by those especially interested in the progress of medicine. Is history to repeat itself in this form of human suffering? What is the bubonic plague? Do we know anything of its specific cause, of its methods of invasion, of the means necessary to combat it? These are questions which I have thought might at this time be of more than passing interest.

Oribasius was physician and friend of Julian the Apostate, and lived in the fourth century of our era. He wrote a medical encyclopædia, composed principally of extracts from older medical authors. This encyclopædia remained unknown in the Vatican Library until the early part of the present century, when it was discovered by that indefatigable student of old manuscripts, Cardinal Mai. In the forty-fourth book of this collection there is a note from Rufus, who states that the physicians of the time of Dionysius were acquainted with a disease which is described as "*Pestilentes bubones maxime letales et acuti, qui maxime circum Libyam et Egyptum et Syriam observantur.*" There follows a description of this disease sufficiently accurate to leave no doubt that it was identical with the bubonic plague. Now, this Dionysius lived about three hundred years before Christ. There is

therefore no doubt that the plague has been known for more than two thousand years.

The next authentic account of the plague is that of the epidemic of the sixth century. The disease at this time was first recognized in Lower Egypt, from which country it extended into Europe by two routes. It was brought from the north coast of Africa, and it also extended through Palestine and Syria, and by this way into Europe. This disease became pandemic and spread, according to the chroniclers of the time, to the "ends of the habitable world." It prevailed in an active form for about sixty years, showing great virulence in certain localities. According to Warnefrid, "it depopulated towns, turned the country into a desert, and made the habitations of men to become the haunts of wild beasts." Hirsch says: "It is impossible to decide whether this outbreak of plague in the second half of the sixth century was the first general diffusion of the disease on European soil, or whether it had been epidemic there before, and if so, to what extent. What is certain is that this outbreak gave it firm hold in Europe, and that it kept its dominion there for more than a thousand years."

It is an interesting fact that this pandemic occurred during the reign of Justinian the Great, the most illustrious emperor of the Eastern Roman Empire. This man, who did so great a service to the world in the codification of the Roman laws, seems to have been both wise and unwise. He is said to have been so filled with Christian ardor that he forcibly baptized more than seventy thousand pagans in Asia Minor alone; and yet he was a pagan by birth, and there is reason for believing that he died a pagan. He is known as the great legislator, and yet he oppressed the people to the verge of starvation by the imposition of unjust taxation, and by granting monopolistic privileges to a few. On one side he instituted just reforms and on the other he fell into reckless and extravagant expenditures. He built the great cathedral of St. Sophia, now a Turkish mosque and one of the architectural wonders of the world, with a treasury filled with the sighs and tears of his overtaxed subjects. I mention these facts in order to show that the spread of the plague occurred at a time when the masses of the people were oppressed by wrong and broken by burdens too heavy to carry.

From the time of Justinian on, for more than ten centuries, as has been stated, the plague raged, sometimes with more, sometimes with less, severity, in Europe. The historians of the time generally content themselves with a statement of its most violent outbursts and an enumeration of its victims. The numbers given must, in many instances at least, be gross exaggerations. It is possible, also, that other diseases, especially smallpox, were in-

cluded in these accounts, but, as Hirsch states, the bubonic plague takes at any rate a foremost place among the great epidemic diseases of those times.

The same author says: "There is only one of the epidemics of the plague in the middle ages that has arrested the attention of the chroniclers, poets, and physicians of those days; and that interest was awakened by the enormous diffusion that it reached over the whole of the then known world, by its victims reckoned in millions, and by the shock to the framework of society which it brought with it and left behind it. This disastrous pestilence, known everywhere under the name of black death, as one of the great events of the world's history, has fixed the attention of writers in a high degree, and has been thought worthy to be painted in minutest details and in the most vivid colors."

Several accounts of the plague of the fourteenth century have become classical. Among them I may mention that of Boccaccio, which begins as follows: "In the year, then, of the fruitful nativity of our Lord, 1348, there happened at Florence, the fairest city in all Italy, a most terrible plague; which, whether owing to the influence of the planets, or that it was sent from God as a just punishment for our sins, had broken out some years before in the Levant"; and concludes thus: "Between March and July following it is supposed, and made pretty certain, that upward of a hundred thousand souls perished in the city only; whereas, before that calamity, it was not supposed to have contained so many inhabitants. What magnificent dwellings, what noble palaces were then depopulated to the last person! What families extinct! What riches and vast possessions left, and no known heir to inherit! What numbers of both sexes in the prime and vigor of youth, whom in the morning, neither Galen, Hippocrates, nor Æsculapius himself but would have declared in perfect health—after dining heartily with their friends here, have supped with their departed friends in the other world!"

This epidemic, like all others of the plague, spread from the East to the West. It prevailed in the Crimea in 1346, reached Constantinople in 1347, and, as we have seen by this quotation from Boccaccio, began its devastations in Florence in 1348, and by the beginning of 1350 it had spread all over the continent of Europe and the adjacent islands. Hecker places the number of deaths from this epidemic at no less than twenty-five millions, or about one fourth of the inhabitants of that part of the globe at the time. Hirsch believes that this estimate was not too high.

The history of the fifteenth century is dotted with notes of local epidemics, and at this time physicians begin to report more accurately and in greater detail the characteristic symptoms and the course of the disease. It was at this time that exanthematic

typhus was recognized as a distinct disease, and distinguished from the other pests of the medical profession.

During the sixteenth and seventeenth centuries the bubonic plague seems to have prevailed as an endemic disease in Europe. There was scarcely a year during these two centuries that this disease did not assume alarming proportions at some place on that continent. The last visitation in England is known as the Great Plague in London, which occurred in 1665. This has been very graphically described by De Foe, and has been the basis of the thrilling story by Ainsworth entitled Old St. Paul. During the last quarter of the seventeenth century the plague seems to have gradually receded toward the East.

During the eighteenth century it repeatedly threatened to extend over Europe, but seldom reached farther than Turkey and the immediately adjacent territory to the north. However, there were as many as eighteen distinct and severe epidemics in Constantinople during that time.

Up to 1841 the plague occasionally became epidemic in the Balkan Peninsula, and there was an outbreak in the province of Astrakhan in the winter of 1878–'79. Since the last-mentioned years it has not appeared in Europe, but has continued in certain parts of Asia. In 1894, just before the beginning of the Chinese-Japanese War, it appeared in a virulent form at Hong Kong. The Japanese Government sent Kitasato and the French sent Yersin to study this disease according to the latest methods of bacteriological research. Both of these men were eminently qualified for the work of their mission, and independently each soon succeeded in isolating the specific bacillus. It is found in the fæces, in the contents of the swollen glands, and in the blood. It consists of rods with rounded ends, which take stains more markedly at the extremities than in the middle. Sometimes the germ seems to be surrounded with a capsule. In beef tea it grows in chains and forms a viscid deposit on the walls and bottom of the tube. It also grows on blood-serum and agar. On potatoes it does not grow at ordinary temperature and only feebly at 38° C. It shows but little motility and grows most abundantly at the temperature of the body.

The bacillus is pathogenic to guinea pigs, rabbits, rats, and mice, and it is stated that at times of the existence of an epidemic of the plague some of these animals acquire the disease, and it has been suggested that they may act as agents in its spread. In the above-mentioned animals the first symptoms manifest themselves usually within from one to two days after inoculation. The animal becomes apathetic, the eyes are watery, the temperature rises, and death, preceded by convulsive movements, comes on within from two to five days. The tissue around

the point of inoculation is inflamed and infiltrated with a bloody, gelatinous exudate. The spleen is enlarged and sometimes the lymphatic glands are swollen. The bacillus is found in the blood and in all the organs.

Mice and guinea pigs fed with pure cultures or with tissues containing the germs die with the symptoms mentioned above. Kitasato found the bacilli in a dead mouse from a plague-stricken house. He also inoculated animals with dust gathered from such houses, and one of these died with symptoms of the plague, and the bacillus was found in its body. In certain parts of Asia the disease is, according to Cantline, known as "rat plague," thus indicating an extensive infection of these animals.

Cantline makes the following statement concerning the susceptibility of rats to the disease: "On all hands rats are reported to behave peculiarly and with a wonderful constancy. Before, or it may be during an epidemic of plague, or before the individuals in any particular house in an infected locality are stricken, the rats leave their haunts and seek the interior of the house. They become careless of the presence of man, and run about in a dazed way with a peculiar limping jerk or spasm of their hind legs. They are frequently found on the bedroom floor or on the tables, but not infrequently their death is known by the putrefactive odor of their decomposition arising from beneath the flooring. So pertinent has this rat affection become, that during the epidemic in Macao in 1895 the Chinese and Portuguese left their houses when the diseased rats invaded their premises. The cause of the rats' behavior is undoubtedly disease, and the symptoms tally wonderfully with plague symptoms of man. Dr. Rennie examined them carefully in Canton, and noted the following post-mortem appearances: (1) The stomach was distended and filled with particles of food, sand, and indigestible substances, and the mucous membrane was red and inflamed toward the pyloric end; (2) the liver was much enlarged and congested, and contained ova of tænia and distoma; (3) there was congestion at the base of the lung present in about forty per cent; and (4) glandular enlargement was present in thirty per cent of those examined. There is no doubt now that the disease in the rat and man is identical. The bacillus of plague has been met with in every case of rat disease of this description when it has been searched for. The infection of the rat is raised from being a mere popular belief into one of scientific precision, and we must now accept the rat, at any rate, as one animal liable to the plague. Whether the rat is affected previously to, coincidently with, or subsequently to man being attacked is open to question. Is the disease among rats a forerunner of its outbreak in man, and, if so, are they a means of infection? These are, of course, two separate questions."

Exposure of the bacillus in thin layers to the direct action of sunlight destroys it after from three to four hours, but to accomplish a like result from exposure to diffuse light as many days are necessary. The germ is killed by an exposure to a temperature of 80° C. for thirty minutes and at 100° C. within a few minutes. Spore formation has not been observed.

There is some reason for believing that there is a pseudo-bacillus of the plague as there is one of diphtheria. In his studies of the soil of the infected districts of Hong Kong, Yersin found a bacillus that resembled that obtained from persons with the disease, both morphologically and in its growth on culture media, but it was without effect upon mice and guinea pigs. He also observed great differences in virulence in the germs obtained from the sick; some of these were without effect upon the above-mentioned animals. There were, moreover, observable variations in the size of the bacilli found in the bodies of the sick and dead.

The studies of Yersin and Kitasato were interrupted by the war between China and Japan, and a much more thorough knowledge of the bacillus and the disease caused by it will probably soon be in our possession.

I will now consider some of the characteristic symptoms of the disease. It is undoubtedly a septicemia, or form of blood-poisoning. As has been stated, the bacillus is found in the blood and in all the organs. It is customary to describe the disease under two forms. The milder epidemics are known under the name of *pestis minor*. In this form the glands of the groins and armpits swell and either suppurate or undergo resolution. There is moderate fever, although in exceptional cases the temperature may reach 104° F. The disease usually continues from ten to twenty days, and may last for from four to eight weeks. *Pestis minor* sometimes precedes and at other times follows the more severe forms of the disease. The former was the case in the epidemics in Mesopotamia in 1873 to 1878, and in Astrakhan in 1878.

Foderé, as quoted by Cantline, makes the following statement concerning *pestis minor*: "In the Levant and in the Marseilles epidemics of 1820, cases were to be seen which were not ushered in by any alarming symptoms, and where the natural functions were undisturbed, and where buboes and carbuncles appeared without fever, or only with slight fever, or the buboes went on to a healthy suppuration more or less prompt, or even disappeared and went on to resolution without the help of art, without any inconvenience, and with a perfect integrity of all the functions. This state is comparable to benign smallpox, during which children play together and walk in the streets without any precautions, no care

being taken of their treatment, and yet terminating favorably. It is the benign plague of authors, which is observed when the disease commences and when it is at its end, though it is rarely seen in the middle period, which is entirely devastating, but it is not less plague, and it no less merits the attention of physicians and magistrates."

In *pestis major* there is a prodromal stage, accompanied by aching in the limbs, shivering, and a high degree of nervousness. The patient seems to be unable to quickly comprehend questions. There is a staggering gait similar to that of alcoholic intoxication. There is intense headache, with thirst and great pain in the epigastrium. The eyes become red; the tongue dry, swollen, fissured, and sometimes black, and at other times covered with a thick white coat. Coma may set in and death result before there is any marked elevation of temperature. In some cases, however, the temperature may reach 107° F. during the twenty-four hours preceding death.

In the cases less rapidly fatal there are glandular swellings. These occur in the groin in about fifty per cent of the cases, in the armpits in about thirty-five per cent, and less frequently in the neck and other localities. One peculiarity of the graver form of the disease is the occurrence of stablike pains in various portions of the body. This symptom gives rise to the superstition among the ignorant that the victim is wounded by invisible arrows shot from the bow of some demon. Suppuration of the buboes with free discharge has been regarded as a favorable symptom. The skin is sometimes covered with livid petechiæ, which become very dark after death. This condition gave rise to the term black death, which has been applied to certain epidemics. Large carbuncles may form in various parts of the body, and these are regarded as a very unfavorable sign.

A highly fatal form of the disease is accompanied by hæmorrhages from the lungs. This was a noticeable feature of the pandemic of the sixteenth century, and it was also observed in the recent outbreak along the Volga. Such hæmorrhages indicate a grave form of intoxication, and have been observed in the severer forms of other acute infectious diseases, such as smallpox.

The virulent form of the plague is often very rapid in its action, sometimes destroying life in a few hours, but the majority of fatal cases terminate about the fifth day. During an epidemic at Bagdad it was said that those who lived until the seventh day were safe, but, according to Colvill, four per cent of the fatal cases terminated after the tenth day.

The mortality from the plague in its virulent form is probably as great as or greater than any other of the acute infectious diseases. In many epidemics it may be more than ninety per cent.

Hecker gives the following statement, which must be an exaggeration, concerning the mortality of the black death: "Cairo lost daily, when the plague was raging with its greatest violence, from ten to fifteen thousand. In China more than thirteen millions are said to have died. India was depopulated. In Caramania and Cæsarea none were left alive. On the roads, in the camps, in the caravansaries, unburied bodies alone were seen. Twenty-two thousand persons and most of the animals were carried off in Gaza within six weeks. Cyprus lost almost all its inhabitants, and ships without crews were often seen in the Mediterranean, as afterward in the North Sea, driving about and spreading the plague wherever they went on shore. It was reported to Pope Clement that throughout the East, probably with the exception of China, 23,840,000 people had fallen victims to the plague."

Probably the most constant pathological lesion found after death from this disease is an enlargement of the lymphatic glands. The disease may run so rapid a course that the enlargement of the glands is not observable during life, but, according to recent and competent observers, changes in these tissues will be found in the great majority of cases. This has led Cantline who studied the disease at Hong Kong in 1894, to propose for it the appellation of "malignant polyadenitis." The same authority offers the following definition: "Plague or malignant polyadenitis is an acute febrile disease of an intensely fatal nature, characterized by inflammation of the lymphatic glands, marked cerebral and vascular disturbances, and by the presence of a specific bacillus."

Geographically the plague has been known as far east as the island of Formosa, where it now prevails; as far west as Ireland; as far north as Norway; and there is no definite information concerning its extension southward in Africa. It has never been known in the western hemisphere, but this is only due to the fact that up to the present time there has been no opportunity of its importation to this half of the world.

In this connection the following quotation from Hecker may be of interest: "The inhabitants of Iceland and Greenland found in the coldness of their inhospitable climate no protection against the southern enemy who had penetrated to them from happier countries. The plague caused great havoc among them. Nature made no allowance for their constant warfare with the elements and the parsimony with which she meted out to them the enjoyments of life. In Denmark and Norway, however, people were so occupied with their own misery that the accustomed voyages to Greenland ceased. Towering icebergs formed at the same time on the coast of east Greenland, in consequence of the general concussion of the earth's organism, and no mortal from that time forward has ever seen that shore or its inhabitants."

There is no known racial immunity to this disease. It is alike fatal to Mongolians, Africans, and Europeans. It has prevailed in the marshes along the Euphrates and on the Himalayas; in densely populated cities and in sparsely settled rural districts; on the sands of Egypt and amid the snows of Norway.

Climate and season have been studied in order to establish between them and the plague a causal relationship. Epidemics have followed prolonged droughts, and have prevailed during rainy seasons. The wind may blow where it listeth, but the bacillus heedeth it not. The epidemic at Hong Kong in 1894 appeared after a prolonged season of dry weather. Rain was anxiously looked for—probably prayed for. It was said, All will be well when the rain comes. At last the rain did come, and with it the disease seemed to be refreshed and the number of deaths was multiplied. The attempt to find in meteorological conditions a cause for our ills is a relic of the superstition of ages when it was believed that disease was sent from heaven to afflict man for his sins, and was due to the anger of the gods.

Overcrowding is undoubtedly a factor in the distribution of this disease, as it is of all other infectious diseases, simply because it renders transmission of the germ from one to the other more speedy and certain; but that the disease can be due to overcrowding is, in the present state of our knowledge, an absurdity.

Poverty and famine are factors in the propagation of the disease. Want of proper food renders the individual more susceptible. This has been demonstrated in case of more than one infectious disease by experiments upon the lower animals. Privation has always been associated with the most notable outbreaks of the plagues. As stated in the beginning of this paper, famine and disease are twin brothers, inseparable. Where one of them dwells there the other may be found. This is undoubtedly the reason why this disease has always found a home in the Levantine. Cantline says: "In the densely packed cities of Asia the poor exist forever on the fringe of destitution, and the least rise in the price of food brings scarcity, so that the term, 'the poor man's plague,' holds good for all time."

There has been much written concerning the period of incubation of this disease, but necessarily all is indefinite. Because a well man comes in contact with a sick one on a certain day, and manifests the first symptoms of the disease ten days later, does not prove that the period of incubation is ten days. The well man may have carried on his person the bacillus from the sick-room, and any time subsequent thereto it may have been introduced into the body. All that is said about the period of incubation of the infectious disease is based on the old theory—long since exploded—that the well man breathes in the miasm at the time of his com-

ing into the presence of the sick one, while the truth is he may carry the germ under his finger nails or elsewhere about him, and there is no telling when it may first find its way into his body. We can determine the period of incubation in the lower animals by inoculation, and here we know that it varies greatly with the method of inoculation, the virulence of the germ, the number of germs introduced, and the susceptibility of the animal. All that may be said about the period of incubation in man is of but little value. The same is largely true concerning the extent to which the disease is contagious. In the epidemic of 1835 in Egypt only one of the French physicians who attended the sick contracted the disease. Bulard, who did not believe the plague contagious, wore for two days a shirt taken from the body of a dead man. He remained well, and thought that by this he had demonstrated the truth of his theory. Such experiments demonstrate nothing. There is no evidence that any of the bacilli were on the garment, or that, if they were, they were introduced into his body. During the epidemic in Hong Kong, fifteen European physicians and a number of Chinese medical students cared for the sick in the hospital, and none acquired the disease. This only shows that with care and cleanliness the sick may be attended without danger of infection of the attendants. Hundreds of bacteriologists in laboratories are daily handling the most virulent cultures of the diphtheria bacillus, and the first case of infection from this source has yet to be reported. This does not prove that these bacilli are not pathogenic to man, or that these men are insusceptible to the disease. Because an expert handles the most venomous serpents without being bitten, does not prove that the bite of these reptiles is harmless.

The exaggerated idea of the contagiousness of the plague held by some of the older writers is exemplified in a graphic way by the following quotation from Hecker: "Every spot which the sick had touched, their breath, their clothes, spread the contagion; and, as in all other places, the attendants and friends who were either blind to their danger or heroically despised it, fell a sacrifice to their sympathy. Even the eyes of the patient were considered as a source of contagion which had the power of acting at a distance, whether on account of their unwonted luster or the distortion which they always suffer in plague, or whether in conformity with an ancient notion, according to which the sight was considered as the bearer of demoniacal enchantment."

The plagues of the middle ages were undoubtedly spread by the processions of the Brotherhood of the Cross. These fanatics went, sometimes in great numbers, from place to place, praying for the sins of the world, and scourging themselves with leathern straps armed with points of iron.

The horrors of the plague of the fourteenth century have been depicted by Hecker and others. The moral depravity brought to light by this great epidemic is hardly credible. Many believed themselves poisoned, and suspicion fell upon the Jews, who have so often been treated by Christians with barbaric cruelty. Under the torture confessions were made, and then began the wholesale slaughter of the children of Abraham. In Basle, the whole Jewish population was brought together in a wooden building constructed for the purpose and burned. "At Strasburg two thousand Jews were burned alive in their own burial ground. . . . At Eslingen the whole Jewish community burned themselves in their synagogue; and mothers were often seen throwing their children on the pile to prevent their being baptized, and then precipitating themselves into the flames. . . . In all the countries on the Rhine these cruelties continued to be perpetrated during the succeeding months; and after quiet was in some degree restored, the people thought to render an acceptable service to God by taking the bricks of the destroyed dwellings and the tombstones of the Jews to repair churches and to erect belfries."

Knowing, as we now do, the specific cause of the plague, we may easily predicate the modes of its distribution. Anything that carries the bacillus may be an agent of its transmission from one person to another, or from one country to another. It is needless to dwell upon this point.

Is there danger of the plague being imported to this country? Yes, there is danger, but this being foreseen may be easily avoided. Thorough inspection of persons and disinfection of things from infected districts will keep the disease out of Europe and America. Only by the most gross carelessness could the plague be permitted to enter either of these continents. The method of disinfecting the mails from the Orient, as practiced by the English, is wholly inadequate, and the American authorities should redisinfect all such matter coming from the infected districts of India.

On the occasion of the opening of the Davy Faraday Research Laboratory at the Royal Institution, London, Dr. Ludwig Mond observed that if Great Britain had distinguished itself in one way more than another in that glorious rivalry with other nations for extending our knowledge of natural phenomena and our power over the forces of Nature, it had been by the large number of contributors to our knowledge who on the Continent would be called amateurs in science—men who devoted their lives to the study and advancement of science from pure love of the subject. He need only instance the names of Cavendish, Joule, and Darwin to say that they included men of the very highest rank.

HIGHWAY CONSTRUCTION IN MASSACHUSETTS.

By CHARLES LIVY WHITTLE, M. E.

IN the course of time there have been many changes in the method of transporting merchandise from town to town and from one country to another. Here, as in everything else, we see the gradual evolution of transportation, at first by man or beast, and finally by steam and electricity. Early man used himself as a beast of burden, and finally the ox and other animals were made to do service in his stead. With every improvement in method came a wider and wider range of trade and its consequent benefits. Efforts to improve the means of transportation resulted in the early invention of carriage by water. Hence we see the maritime peoples were the first to attain any considerable commercial prominence.

At the time this country was settled the lack of adequate means of moving commodities, excepting by water, led to the settlement of lands bordering the ocean, streams, and lakes, while equally good lands, not in close vicinity to water, offered but little attraction to the settler. Gradually the frontier was pushed farther westward; the narrow and obscure Indian trails were transformed into paths for horses and eventually became carriage roads. Before the railroad was devised public roads that possessed any claims to excellence were limited to the more populous States bordering the Atlantic coast. It is without doubt true that, had not transportation by rail been invented until the present time, the public roads of this country would be in a far more satisfactory condition than we find them to-day. With the advent of the locomotive came the withdrawal of active interest in the character of our highways. All the energies of our people were devoted to extending and perfecting the vast network of railroads that cross and recross the United States. Railway construction has now reached an equation of demand and supply, and we once again see the Commonwealths awakening to the importance of good roads, many communities vying with one another in their efforts to lead the States and earn a reputation for the excellent character of their highways.

The natural conservatism of the farming element of our people has been a difficult feature of the problem of arousing public interest in better roads to overcome in the past. The farmer has had but few object lessons in what a road should be. Adding to this the objections he has to an increase of taxation, we perceive the difficulties that stand in the way of educating the people up to the point of appreciating the numerous advantages that would accrue to them with a system of highways properly constructed

and maintained. Little attention has been paid by the rural dweller to the arguments in favor of good roads. His line of reasoning is that roads that were satisfactory to his father and grandfather are good enough for him. In vain has he been told that, with good roads all the year round, the farmer and merchant come into closer communication; that he can sell his stock and grain when prices tempt him, instead of being dependent upon a favorable state of the road; that he can buy his supplies on rainy days, and increase his number of perishable crops, which are of uncertain value with bad roads, but become of certain value when impassable ways cease to cause spasmodic transportation.

To-day State roads are furnishing the farmer the much-needed object lessons—roads which by their general excellence throughout the year are causing, as in some counties in New Jersey, a marked increase in farm values. Other States, as Massachusetts, are building highways with State money, one fourth of which is eventually returned to the State by the county traversed by the way, while the legislative enactments of other States require a portion of the expense to be borne by the county in which the road lies, and by the freeholders whose property immediately abuts the improved roads. The mutual benefit derived from improved highways by all classes of people is now generally recognized in the more thrifty States, and from now on we may expect with surety the gradual development of our highways until the principal thoroughfares of the country come up to the required standard of excellence.

Travelers have described the celebrated Peruvian military road, leading from Cuzco to Quito, that was constructed long before the time the Spaniards conquered that country, about 1544. This road is variously estimated at fifteen hundred to two thousand miles in length, passing over deep cañons and across high mountain ranges. Large sandstone blocks formed the foundation, and this was covered with a native cement of a bituminous nature, forming a very smooth surface possessing great durability. Some portions of the road are still in an excellent state of preservation. The Romans also constructed over ten thousand miles of paved ways; but none of these ancient builders understood the principles made use of to-day.

The art of building the type of road known as the modern highway is not a new one. The second decade of this century in England witnessed the first examples of turnpikes constructed on scientific principles in that country as enunciated by Macadam. Like many discoveries, the first and one of the most important principles involved is one that we should expect would have been discovered and put in general practice long before 1816. At that

PLATE I.—STATE HIGHWAY, WESTFIELD, MASS. Showing subgrade rolled and first layer of broken stone in place.
(From photograph loaned by the Massachusetts Highway Commission.)

time it was the custom in Great Britain, as elsewhere, to build roads very largely of clay or gravel. Macadam observed that gravel never afforded a good, compact wearing surface until a large amount of traffic had passed over it, when it became hardened and cemented together. He sought an explanation of this phenomenon, and learned that when the pebbles were broken under the impact of heavy wheels they soon consolidated into a firm mass. Here was the great principle: angular stones solidify under pressure; rounded stones do not.* Amplifying this principle, he built up a complete system of road building which is in use to-day, as best shown in Switzerland and France, in England, and in other foreign countries, and is being revived so generally in this country at the present time, where the farmer is learning its advantages in the appreciation of land values, and where the bicyclist promotes the cause as the advance agent of good roads.

As defined by Macadam, a good road should be a hard, somewhat elastic surface to receive the wear of all kinds of traffic at every season of the year and during the greatest vicissitudes of weather, which shall also serve as a roof to that part of the road lying below. To use his own words, "A road ought to be considered as an artificial floor, forming a strong, smooth, solid surface, at once capable of carrying great weights, and over which carriages may pass without meeting any impediment." In order to realize such a surface it is necessary that the substructure of the road should be kept free from water, since, by the alternating freezing and thawing of the water, the wearing surface of the broken stone is disrupted, the water is offered a passageway through it, and the road becomes rough and difficult to travel.

It was the custom of Macadam, after the engineering work was completed and the subgrade established, to spread on a layer of stone to a depth of ten inches and to roll this surface with a heavy roller drawn by horses. These stones were broken by hand with small hammers, frequently a whole family working together, and were broken small enough to pass through a three-inch ring, or were not to have a maximum weight of over six ounces. A family of five people could break several tons per day. Side ditches were excavated where necessary, so that at no season of the year could water penetrate to the substructure of the road.

In 1816 Macadam began the construction and maintenance of one hundred and eighty miles of turnpike in Bristol District,

* It is not improbable that Macadam was acquainted with the Napoleonic military roads constructed in France about 1775, which involved the principle of a thin layer of broken stone placed on a rock foundation. These roads were the invention of Tresaguet, a Frenchman, at about this time, and to him seems to be due the credit of first constructing what is now known essentially as the Telford system.

England.* A modification of this system was adopted by Thomas Telford about this time, which substituted a layer, or foundation, of irregular broken stone, set up on edge on the subgrade. Nine inches was the maximum dimension of these fragments. The rough surface thus made was smoothed down by going over it and breaking off the tops of the blocks with small hammers and packing the pieces thus obtained between the large blocks. This surface was then rolled as before. Telford built the celebrated Holyhead road, extending from Holyhead through North Wales to Shrewsbury—a road that served as a model at the board of inquiry appointed by Parliament in 1823. Each system had its partisans, and to-day the best features of both methods have been adopted under different conditions, dependent upon the character of the ground over which the road passes.

In 1892 the State of Massachusetts appointed a commission to investigate and report upon the character of the highways of the State, and to point out the trend that legislation should take in the matter of framing laws appropriating a yearly sum of money for the construction of State roads, and defining the powers of the Highway Commission to be appointed under the same act. This commission made its first report in 1893, and, on June 20, 1894, the Legislature appropriated the sum of three hundred thousand dollars for this purpose, to be used at the discretion of the Highway Commissioners the ensuing year. This commission appoints its own chief engineer, who has ultimate authority with the commission in the settlement of all questions that arise in connection with the work.

The laws enacted at this time do not place the initiation of State roads directly in the hands of the commission, but make the commissioners the tribunal to which all petitions made by towns, cities, or counties of the State are referred for action. It is a part of the policy of the commission not to allow a random construction of isolated stretches of road, but to make all ways constructed fit into a general scheme that shall have for its object a system of thoroughfares traversing the State that shall benefit the greatest number of municipalities and the State as a whole.

The method of procedure, as defined by the statute of 1894, is as follows: The selectmen of any town, the aldermen of any city, or the county commissioners must first file a petition with the Highway Commissioners, accompanied by a plan and profile of the road. Plans are then prepared by the chief engineer and submitted to the commission for its approval. It is a part of the set-

* Although one of the earliest pieces of work on a large scale that was ever attempted, the report of the board of inquiry, referred to above, showed that similar roads had been built in Sweden previous to 1823.

PLATE II.—STATE HIGHWAY, WESTFIELD, MASS. Showing steam roller at work on screenings. Finished roadway in the distance. (From photograph loaned by the Massachusetts Highway Commission.)

tled policy of the commission to reduce all grades to a maximum of five feet in one hundred—called a five-per-cent grade. After courses and distances are plotted, and the necessary data obtained for determining the quantity of the various materials used in the construction of a road, a conference is held between the petitioners and the State commissioners, in order to ascertain if a contract for the construction of the road is to be made by the municipality, and, if so, at what price it is to be done. In case the city or town authorities are unwilling to contract for the work upon the prices agreed, the commission advertises the same, and it is let to the lowest responsible bidder, subject to the approval of the Governor and Council. It is the custom in awarding competitive contracts to require the contractor to furnish bonds: one insuring a faithful completion of the work; the other to safeguard the interests of the town or city in case damage results from accidents during the building of the way. Upon the contract being made and a notification being received that the municipality or contractor is ready to proceed with the work, the commission appoints a resident engineer, who has personal charge of the work of construction, subject only to the supervision of the chief engineer.

Now comes the period of actual construction, and the first step in advance is the excavation and filling the road to the required subgrade. In general the subgrade is about nine inches below the finished grade; but the extent of excavation differs widely in actual practice, owing to the different treatment necessary as determined by the varying character of the ground. The subgrade established and rolled, broken stone is then added to a depth of six inches, the fragments varying in size from one and a quarter to two and a quarter inches in their longest dimension. This is then rolled with a steam roller until thoroughly compacted (Plate I). A second layer of broken stone, three inches thick, is next spread upon the road, the pieces ranging in size from one half to one and a quarter inch. This is then rolled as before, and a finishing coating of screenings, put through a half-inch mesh, is then added to a depth of half an inch. Water is now turned on until the broken stone is well wet down, when the final rolling is done, and the surface becomes firmly and smoothly knit together (Plate II). In the foreground of this picture the second layer of broken stone is seen. The main part of the road is in its completed state, having just been compacted with the steam roller. Some modifications are made in these steps of the process, depending upon the quality of the stone used and the amount and kind of travel to which the road is to be subjected. As pointed out by Macadam, it is not wise to place a layer of broken stone directly upon a subgrade of granite

or other rock existing as a ledge. Owing to the loss of the element of elasticity, the road would soon become weakened in its coherency, and the rate of wear would be much increased. It is therefore customary to excavate, when a cut in rock is necessary, some four inches below subgrade, and to fill in to subgrade with gravel on which the broken stone is placed as before.

Another modification is practiced when clayey, wet ground is encountered. Under these circumstances it is generally best to excavate some sixteen inches below the finished grade and spread on a layer of gravel four inches deep. Upon this Telford foundation is laid by hand to a depth of eight or ten inches and carefully rolled (Plate III). A layer of broken stone is then put on, and a finishing coating of screenings is added as before.

As to the character of the roads already constructed in Massachusetts, Prof. N. S. Shaler, of the Highway Commission, informed the writer that, in his opinion, they are in no way inferior, in so far as quality and durability are concerned, to the celebrated Swiss roads.

So well pleased are the people of Massachusetts with the State roads already constructed, and so active are they in the cause of good roads, that the Legislature appropriated the additional sum of four hundred thousand dollars for highway construction during the year 1895 and five hundred thousand dollars in 1896.

At first glance it would seem that the engineering skill necessary to construct a Macadam road would not be of a particularly high order; and yet the problems involved in building roads in the latitude of Massachusetts, where great variations exist in the character of the soil, owing to the glacial conditions that once existed here, call for engineering ability of a peculiar kind, as well as an extended experience in the treatment of special cases and the economical application of the materials at hand.

As an adjunct of the Highway Commission, a laboratory has been established in Cambridge, where the systematic study of road materials is carried on. It has come to be generally recognized that materials which possess the necessary qualities for a good road stone are both limited in kind and in quantity. It is the object of these laboratory investigations to classify the road stones of the State in the order of their fitness for this purpose, and to prepare a map showing the area and location of the most desirable varieties. Here are investigated the questions of the rate of wear of stones under impact, and the cementing and recementing value of the powdered rock on which the life of the road depends in a large measure. The hardness and toughness also come within the scope of the experimental work. Experiment has shown that a stone must possess certain all-around properties in order to come up to the desired standard. For

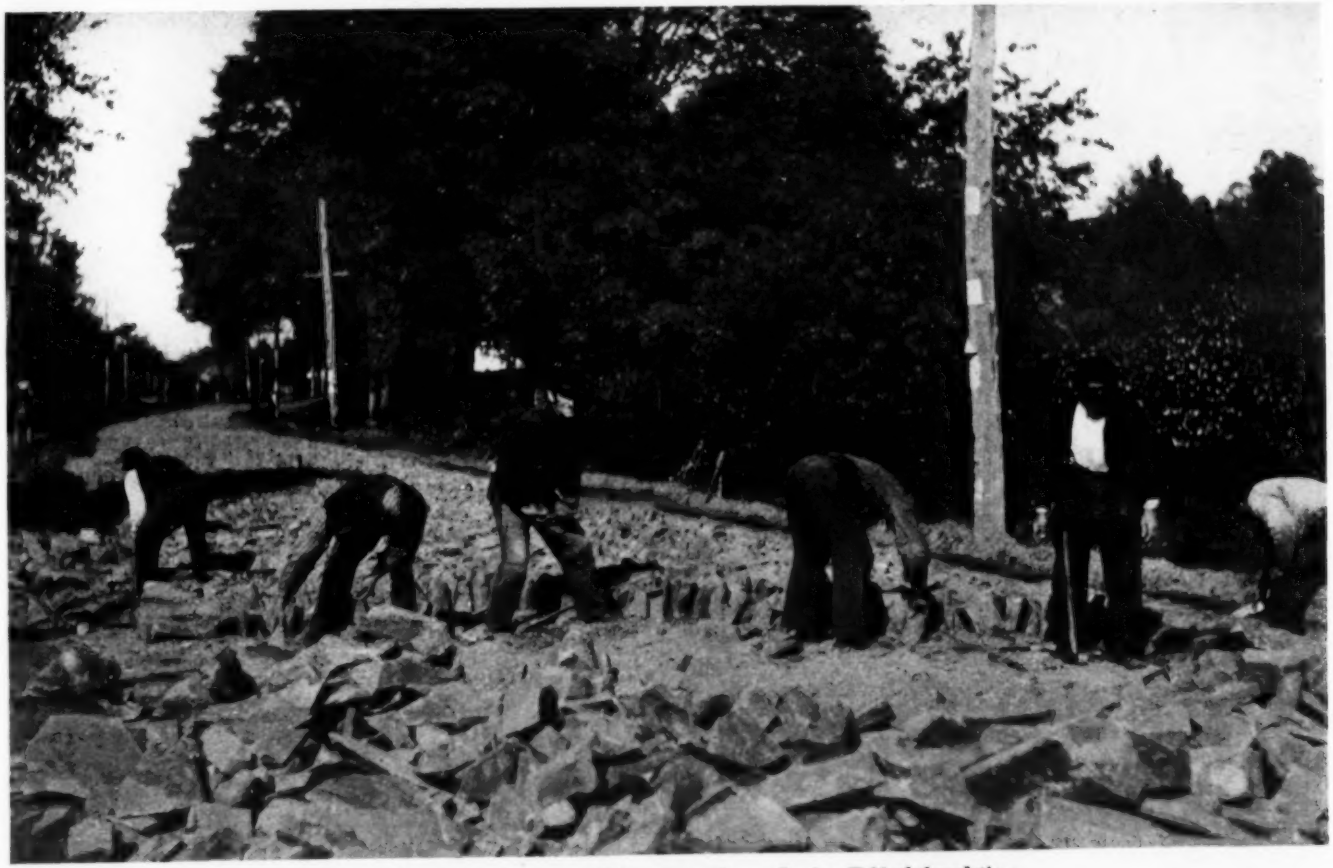

PLATE III.—STATE HIGHWAY, WESTFIELD, MASS. Laying Telford foundation.
(From photograph loaned by the Massachusetts Highway Commission.)

example, quartz or quartzite has a hardness of seven in a scale of ten, and for this quality alone it is best suited for road building of any rock of common occurrence; but it does not possess any cementing power or elasticity whatever, and is therefore of little use for Macadam work. As a result of long trial on roads in England and on the Continent, it is found that the stone best suited for road metal must possess toughness and cementing qualities and as great a resistance to abrasion as is possible in a stone having the first two properties. It is an important fact that experimental investigation in the laboratory has pointed scientifically to the same conclusions that have been obtained from the severe test of long experience in actual use.

The most important road stones are known under the common names of "trap" or "dike stones." They are usually of a dark-green color, are fine-grained, and are composed essentially of the minerals pyroxene or hornblende and feldspar, the individual minerals often not being visible to the unaided eye. Geologically, they are rocks that have been forced up through fissures in the earth's crust from great depths, where they existed in a melted condition. Rocks of this kind are very numerous in eastern Massachusetts and generally throughout the old mountain ranges of the United States. The road engineer, however, has other materials besides quarry stone, which, though not possessing so many good qualities, nevertheless make excellent road metal under proper conditions. Among these may be mentioned the blue glacial gravels, kame gravels, beach pebbles, and field stones.

Another rock in common use in various parts of New England is granite (a mixture of the minerals quartz and feldspar) and the allied rock, gneiss. Both these rocks are normally coarse-grained, possessing a hardness, as measured by that of their component minerals, a little under seven. In its use as broken stone granite has certain advantages over quartz alone, in that the feldspar, when pulverized or decomposed by the action of the weather, has considerable cementing value; but the decomposition of the feldspar liberates the quartz, and the physical differences in the matter of hardness, cleavage, etc., between the quartz and the feldspar promote differential wear of the stone as well as other defects. Granite, however, is an important road stone, and is far superior to such rocks as limestones, slates, or marbles, which, owing to their softness, are rapidly worn out.

The production of broken stone has now assumed such importance that several concerns in Massachusetts are making a regular business of furnishing all sizes to the State or municipalities. Broken stone, as a commercial commodity, is now sold on the cars at about one dollar to one dollar and seventy cents per ton for the best quality of trap.

THE DAVENPORT ACADEMY OF NATURAL SCIENCES.

By FREDERICK STARR.

THE scientific work of our Government bureaus and of the great universities of our country is of supreme importance and justly arouses the pride of every American. It is not likely to be overlooked. The work of local societies is less imposing, but is of the highest importance and calls for more than a passing word. In many American cities there are organizations of persons who are intelligently interested in science. These hold regular meetings for discussion, publish papers as new contributions to science, and gather museum collections which serve as object lessons to the public. Few persons realize how much such local organizations, supported by private means and personal enthusiasm, are doing for the cause of science. To make known the story of some of these academies of science and to sketch their work is the purpose of the series of articles of which this is the first. To present their achievements and their claims to respect and assistance is a task which the author gladly undertakes, being one of the many students who have been helped and encouraged by them.

The choice of the Davenport Academy of Science as the subject of this first article is simply from convenience. In some respects the story of its origin and development is typical, in others unusual. There is rather more of personality in it than in most, for the Davenport Academy has had a peculiar environment. When it was organized the city of Davenport was in the "far West"; opportunities for literary and scientific work were meager; the town itself was small, commercial, unsympathetic. That any organization of its kind so far from other centers should exist and thrive was astonishing.

In 1867, on December 14th, four gentlemen—Messrs. L. T. Eads, A. U. Barler, A. S. Tiffany, and W. H. Pratt—met in a business office to organize a natural history society. No one of the four was a professional scientist; all were busy men; none of them was really wealthy. They added names enough to their own to supply officers and a board of trustees, drew up a constitution and by-laws, and then and there became an actual society. Thereafter regular meetings were held and topics of more or less scientific importance were discussed. Before a year had passed the membership had grown to more than fifty, and the attendance at the meetings indicated continued interest. A cabinet of natural history was begun and a place for its display was secured in the rooms of the Davenport Library Association. The first sign,

however, that the organization was really purposing to advance the sum of human knowledge was given when the academy arranged for the scientific observation of the solar eclipse of August 7, 1869. The undertaking was a somewhat serious one for the little group of workers. Money had to be secured and subscription lists were passed. Arrangements were made for photographing, and during the two hours of the shadow three dozen negatives were made, of which twenty were fairly good. From them sets

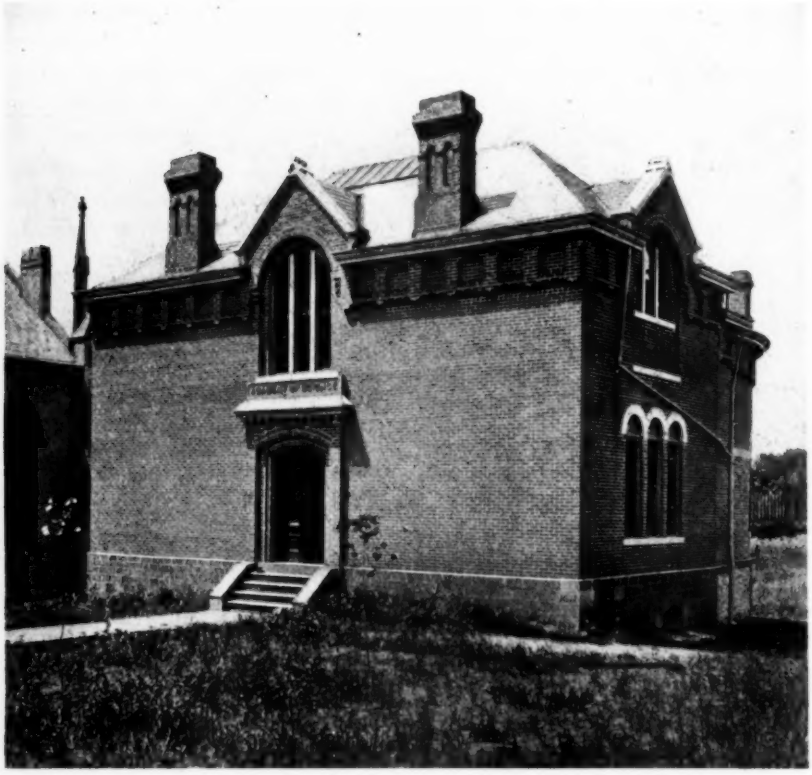

FIG. 1.—BUILDING OF THE DAVENPORT ACADEMY OF NATURAL SCIENCES.

of prints were made, some of which were sold to repay expenses, others of which were sent to foreign societies. It was the first exchange contact of the academy with the scientific world.

In July, 1873, the academy, now nearly six years old, rented "a small back room," into which it put three or four cases for its collection and where for the first time it felt itself at home. The next year more commodious quarters were obtained in the Odd-Fellows' Building. Increasing activity showed itself by weekly *conversaziones* of a popular kind in addition to the regular meetings, by the purchase of a geological library, and by field work in

local archæology. More room was necessary, and the lady members—for lady members had been determined to be a good thing—bestirred themselves to secure and furnish a second room. This was progress, but greater things were in mind. Even as early as March, 1873, there was talk of buying property or a building. At that time a combination scheme was in mind, the Library Association, Horticultural Society, and academy uniting in the purchase. Fortunately, the plan failed. On Washington's birthday, 1877, Mrs. Newcomb donated a building lot to the academy. The fever to build was fanned. Before the year ended plans were drawn up and the building erected. Just one year to a day from the donation of the land the building was opened.

The first president of the academy was Prof. David Sylvester Sheldon.* He was born in Vermont, December 6, 1809. At sixteen years of age he went to Castleton Academy, and three years later to Middlebury College, where he was graduated in his twenty-third year. Studying theology at Andover, he never preached, but entered the vocation of teaching. For a time he was principal of the academy at Bennington, Vt., then taught at Potsdam, N. Y., and still later at Northampton, Mass. At thirty-nine years he had lost health and was compelled to travel in the South. Going West later, he settled at Burlington, Iowa, in 1850. When forty-four years old he accepted the chair of Natural Science in Iowa College, then located at Davenport. Later on the college removed to Grinnel, but Prof. Sheldon remained in Davenport, where subsequently he took a professorship in Griswold College, retaining it until his death in 1886. Prof. Sheldon was an inspiring teacher, a man of excellent thought, and of kind and lovely character. He was an ardent collector and student, but not a writer. Local zoölogy and botany occupied much of his attention, and the remarkable collection of fresh-water *Unios* which he made greatly delighted Louis Agassiz. In his botanical field work, the afterward eminent botanist Sereno Watson, then a young man, was associated with him. When the Academy of

* The list of presidents of the academy is as follows:

1867.—Prof. D. S. Sheldon.
1868–'69–'70–'71–'72–'73–'74.—Dr. C. C. Parry.
1875.—Dr. E. H. Hazen.
1876.—Prof. W. H. Barris.
1877.—Rev. S. S. Hunting.
1878.—Dr. R. J. Farquharson.
1879.—Mrs. Mary L. D. Putnam.
1880.—Prof. W. H. Pratt.
1881.—J. Duncan Putnam.
1882.—Dr. C. H. Preston.
1883.—E. P. Lynch.
1884.—H. C. Fulton.
1885–'86.—Charles E. Putnam.
1887–'88.—Charles E. Harrison.
1889–'90.—Dr. Jennie McCowen.
1891.—James Thompson.
1892.—James Thompson (died night of his election, Dr. William L. Allen, 1st Vice-President, acting President 1892).
1893–'94.—Dr. William L. Allen.
1895–'96.—Edward S. Hammatt.

Science was organized, Prof. Sheldon, then a man of sixty years, was urged to be president. He retained the office only a few months, but up to the last week of his life he was the academy's trusted counselor, constant supporter, and faithful friend.

Fortunately, there was then in Davenport one who was a professionally scientific man—Dr. C. C. Parry. For more than six

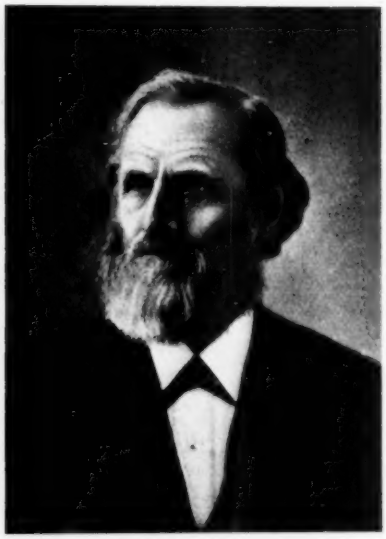

FIG. 2.—DAVID SYLVESTER SHELDON.

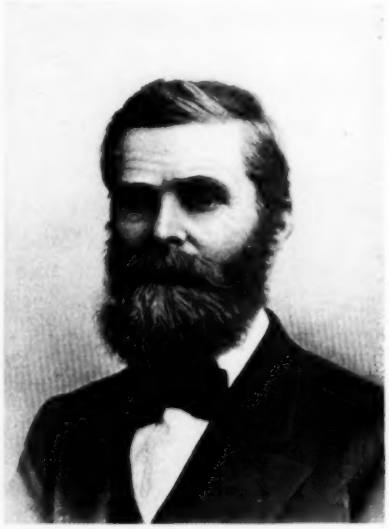

FIG. 3.—CHARLES CHRISTOPHER PARRY.

years he was president of the academy. From the start he held the idea that the academy was called to a higher purpose than to supply pastime to a few townspeople. Charles Christopher Parry was born in Admington, Gloucester, England, August 28, 1823. When he was but nine years old his parents came to this country, settling in Washington County, New York. Educated at Union College, Schenectady, he studied medicine at Columbia College. He settled in Davenport in 1846. There he was a diligent student of the local flora. Later on he examined the mountain flora of California, Colorado, and Mexico. He was official botanist of the Mexican Boundary Survey. Later he held official positions in the Department of Agriculture and as special agent of the Forestry Department of the census of 1880. His journeys to every part of our great Western mountain region were extensive and scientifically productive. He was the discoverer and describer of many new species of plants and of several important genera. His name is associated with that of Torrey and Gray both in geography and on the pages of botanical literature. A man of energy, convictions, and heart, he was the very one to shape and mold a

young society's work. In one of his presidential addresses before the academy, Dr. Parry emphasized the importance of three things to be held constantly in mind toward which to work. These were (1) a home, (2) a complete *local* collection, (3) publication. These three aims have ever been before the academy. We have seen how they gained the first; the second has been in view from the very inception of the society; the third began early to be agitated.

The election of a schoolboy to membership in a scientific society might seem to mean little, but to the Davenport Academy it meant much. One of the charter members of the academy, Prof. Pratt, was writing teacher in the public schools, giving instruction from building to building. At times he told the scholars to write anything they might have in mind on slips of paper and to hand them in to him. On one such occasion a boy not fourteen years of age wrote the words *Davenport Academy of Natural Sciences.* On inquiry, Prof. Pratt found that the boy had read of the academy in the newspapers and wanted to know what it was. When told of the meetings and collecting excursions he desired to become a member, but only if his mother could become one also. The question of lady members had not before been raised, but now posed it was soon solved. J. Duncan Putnam and his mother were elected to membership, June 2, 1869. The ardent enthusiasm of the schoolboy and the mother's love were to do more for the academy than the few members voting at that meeting could realize. It was this mother's interest that led to the second rented room, to the donation by ladies in 1875 of new cases and carpets, to the gift by a woman in 1877 of the lot, and to much of the energy and interest displayed by the townspeople since. It was the boy's enthusiasm and the mother's love that led to the publication. Impelled by Dr. Parry's words and his own feeling of its importance, J. Duncan Putnam on November 26, 1875, then a boy of nineteen, urged the academy to publish Proceedings. A committee was appointed to look into the matter and to devise means if possible to carry out the plan. December 20th a company of ladies—the Women's Centennial Association—agreed to see that the first

FIG. 4.—J. DUNCAN PUTNAM.

volume of Proceedings, covering the years 1867–'75, should be printed. It was no easy task. Entertainments were given and other ways of raising money devised. A fire interfered seriously, but at last the handsome octavo volume was printed and turned over to the academy. The volume formed part of the display of women's work and achievement at the Centennial at Philadelphia in 1876. The happy result of publication upon the academy was immediately apparent. The Proceedings were sent to all parts of the world, and the library of the academy has grown almost entirely out of its exchange. The publication has not only benefited the scientific world by making known valuable original work, but it has made the academy widely known. The Proceedings have been continued up to the present time, and Volume VII is now in progress. During his lifetime the Proceedings were ever in J. Duncan Putnam's mind. Volume II was due to him, and early in 1881 he offered to turn over to the academy a complete printing outfit and to personally superintend the publication of Volume III. He did not live to complete it, and that volume is a memorial volume, the final bringing out of which is due to Mrs. Putnam. Since her son's death this lady's great desire in connection with the academy has been to see the publications continued. Her energy has never flagged, and finally she has seen the future of the Proceedings assured.

FIG. 5.—MRS. M. L. D. PUTNAM.

One of the notable papers in the first volume of the Proceedings dealt with the archæological treasures found by the academy's workers in the mounds of Iowa and Illinois, not far from the city. Local archæology began to attract the academy's attention about 1873. A little group of interested students did the work of exploration mainly at their own expense and often with their own hands. Important objects had been found. In 1874 the academy published a series of seventeen photographs of seven mound-builder skulls. At the 1875 meeting of the American Association for the Advancement of Science, Dr. Robert James Farquharson represented the academy and read a paper upon these finds. It was this paper to which reference is made above. Its author was no common man. Born of a Scotch father and a

Kentucky mother at Nashville, Tenn., July 15, 1824, he was a graduate of the University of Nashville in 1841. At that time Dr. Gerard Troost was connected with that institution, and young Farquharson was profoundly impressed by him. Graduating in 1844 in medicine at the University of Pennsylvania, Dr. Farquharson settled as a practitioner in New Orleans in 1845, and in 1847 was appointed assistant surgeon in the United States Navy. Resigning in 1855, he returned to Nashville and married there. Through the war a strong Unionist, he was in hospital service, and at its close removed to Arkansas. In 1868 he went to Davenport. He joined the academy in its first year, and for twelve years was an important factor in its work. In 1880, being appointed to the State Board of Health, he removed to Des Moines, where he resided until his death in 1884. Unusually modest, quiet, and unassuming, Dr. Farquharson was a profound thinker and an original investigator. Among his notable studies was an interesting investigation upon Leprosy in Iowa.

In this same first volume were several important entomological papers by J. Duncan Putnam. Mr. Putnam's election has already been mentioned and his interest in the Proceedings described. In the history of American entomology there are no more devoted workers. Although dying when most men begin work, he had accomplished more than many who live long. He was born at Jacksonville, Ill., October 18, 1855, his mother being the daughter of the second Governor of Illinois. When a boy of eleven years he began collecting insects, and three years later was a serious student of his gatherings. He joined the society in 1869, and at fifteen years of age, in 1871, was its recording secretary. In 1872 he took a three months' trip into Colorado, where he met John Torrey and Asa Gray, with whom he formed a lasting friendship. In 1873 he was appointed meteorologist on the Jones Yellowstone Exploring Expedition, which was in the field for five months. Returning home, he continued his preparation for Harvard College, but was obliged to give up all hope of a collegiate course on account of failing health. It was in December of that year that his first hæmorrhage of the lungs

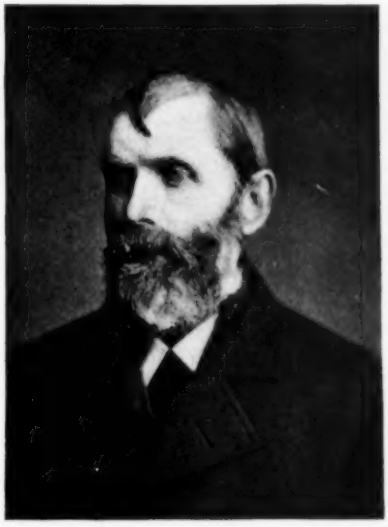

FIG. 6.—ROBERT JAMES FARQUHARSON.

occurred. Although knowing perfectly what lay before him, the young man kept unflinchingly onward. Wrapped up in his loved science and toiling like a strong man in the service of the academy which had won his boy-heart, he kept happily and wholesomely busy to the very end. His labor in a loved cause no doubt prolonged his life, but at last, December 10, 1881, the long-expected summons came. The monument of that young life consists of a series of papers, chiefly entomological, of no mean merit—and the academy. In 1872 Duncan Putnam found his first specimen of *Galeodes*. This belongs to the family *Solpugidæ*, a curious group related to the spiders and scorpions. From that date on his interest centered upon this little-known and curious group. To so good profit did he labor that even now in our latest general authoritative work on insects Prof. Comstock names Putnam as the chief authority. The results of his study were not fully ready for publication at the time of his death, but Prof. Herbert Osborne put them in shape for the printer. They comprise one brief paper—Notes on Solpugidæ, an important Bibliography, and data for a Monograph upon the American Galeodidæ. All of this material, beautifully illustrated by the author's own drawings, was published in the memorial volume of the Proceedings. Besides the material upon the *Solpugidæ*, Mr. Putnam's work includes a score of important papers which were printed in the Proceedings, Popular Science Monthly, United States Government reports, etc. The whole motive in J. Duncan Putnam's work was to do what ought to be done. As he himself once said, "If others are unwilling to do what ought to be done, *I must.*" No one outside his family knew him better than Dr. Parry, who said of him: "Though over thirty years his senior in the broad field of Nature, we occupied the same level. Always respectful to my personal wishes or suggestions, never flinching from any imposed duty, always cheerful, hopeful, and zealous, he proved a companion worthy of the highest regard, which he never forfeited either by word or deed." By his activity in field work Mr. Putnam gathered a collection of twenty-five thousand specimens, representing more than eight

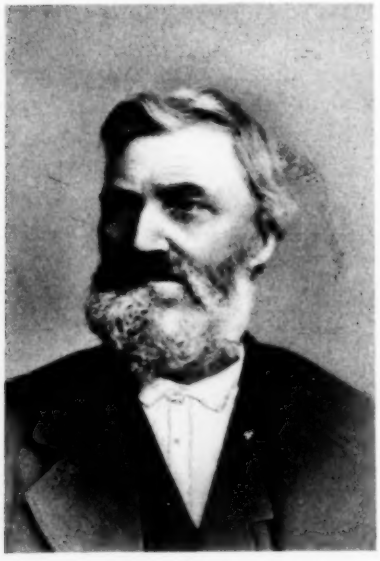

Fig. 7.—Captain Wilfred P. Hall.

thousand species of insects. Some of these were type specimens from which he had himself described new species. This whole collection, together with his entomological library, was turned over by his parents to the academy, upon certain conditions securing its proper care and integrity, June 25, 1886.

The archæological work of the academy has been done in two localities. Among Davenport residents who have been interested in the academy is Captain Wilfred P. Hall, better known as "*the old man of the skiff.*" Captain Hall through a long series of years made great journeys on the Mississippi and its tributary streams in a little boat. Among the Arkansas mounds he made extensive diggings and collected many beautiful and valuable relics. The district is a rich one, especially in objects of pottery and shell. When fine specimens were found in private hands, the captain would secure them by purchase or exchange. In his barter, books, including dictionaries, were of special use. After every trip Captain Hall brought back new and interesting material, until the academy's collection was one of the finest, if not the best, from that district. It was this collection that supplied the better part of William H. Holmes's important paper upon the

FIG. 8.—POTTERY FROM ARKANSAS MOUNDS.

Ancient Pottery of the Mississippi Valley.* Captain Hall's collection is still one of the strongest features in the academy's museum, and the old skiff in which he traveled so many thou-

* Proceedings, vol. iv. Expanded to cover a larger field and under another title in annual report, Bureau of Ethnology.

sands of miles is still preserved on the academy's grounds. The other region archæologically explored by the academy is the local field immediately around Davenport. In the investigations here some most important facts regarding mound construction and burial have been secured and curious and valuable relics found. Among these local relics are skulls, objects of shell, carved stone pipes, copper axes wrapped in cloth (the structure of which has been preserved by impregnation with salts of copper produced by atmospheric action), and stone tablets bearing inscriptions or pictorial designs. None of these relics have attracted so much attention as two of the stone pipes, called from their shape "elephant pipes," and the tablets, which are three in number, two of black slate and one of limestone. About the authenticity of these five objects a bitter controversy has waged. The matter first appeared within the academy August 29, 1884, when attention was called to an article by H. W. Henshaw in the Second Annual Report of the Bureau of Ethnology. In this article the authenticity of the elephant pipes was seriously impugned. A committee was appointed to look into the charge and meet it. A somewhat acrimonious discussion, in which many took part, was conducted in various periodicals. Mr. Charles E. Putnam, father of J. Duncan Putnam, and president of the academy, prepared a vindication, which was published as an independent pamphlet, and later republished with an appendix of congratulatory letters from various archæologists. While this is not the proper place for discussing the authenticity of these specimens, it may not be out of place for the writer to say that to his judgment no substantial argument

FIG. 9.—COPPER AXES WRAPPED IN CLOTH.

by the opposition demonstrates either the falsity of the specimens or fraud on the part of the academy. A careful examination of the objects themselves by a disinterested and impartial committee has never been made. Until it has been, every expression of opinion can only be personal.

Up to the year 1883 there was no paid office in connection with the academy. Early in 1882 the heavy labors devolving upon the curator were emphasized, and the payment to him of a salary was uged. Toward the end of that year the modest sum of five hundred dollars was voted as salary, the incumbent being Prof. W. H. Pratt, one of the original four of 1867. At about the same time the financial condition of the academy made a vigorous effort on the part of its friends to relieve it from debt quite necessary. There was a little balance of indebtedness upon the building and other obligations had arisen. An appeal was made to the city, and a citizens' meeting was held on April 24, 1883. At that meeting twelve hundred and ninety dollars was subscribed, and, by a short canvass among the citizens, that sum was raised to twenty-nine hundred and sixty dollars, more than enough to pay all debt. The surplus, amounting to nearly one thousand dollars,

FIG. 10.—SLATE TABLET, DAVENPORT.

was set apart toward a permanent fund, the interest only on which was to be available.

Just at this time of favorable financial condition came the attack upon the elephant pipes. Whether this was intended to harm the academy or not, it had that result. The society was already weakened by loss of active members. Death or removal had taken from the academy Sheldon, Putnam, Parry, and Far-

quharson. Interested and self-sacrificing members remained, but they were not professional scientists. The attack surprised some, disgusted others, discouraged more. A few brave workers kept their hands on the work. Among them the curator was indefatigable. The care of the collections was but a small part of his labors. Besides that he had many of the cares of correspondence and of the library. He it was who encouraged the young members of the Agassiz Associations. To make the academy useful to a larger company than its own membership, he organized and delivered courses of popular lectures to the children of the public schools; these were given at the academy, and were illustrated by its collections. Classes from the different schools had their set times for these lectures, and the result of them was encouraging. The experiment might well be tried at other places.

FIG. 11.—SLATE TABLET, DAVENPORT.

While not directly an academy enterprise, it is certain that its work and influence led to the holding of the second annual convention of the Agassiz Associations of the United States at Davenport in 1886. There were then two flourishing chapters of the "A. A." in the city, one at the high school and the other in the grammar schools; the combined membership was about seventy. That the active young members of these chapters drew a large amount of their interest from the academy is beyond doubt. The meeting at Davenport was a great success, and young scientists throughout the United States were stimulated by it.

With the death of Charles E. Putnam and the later removal of the patient curator to Minneapolis, the little force of workers was still further reduced. The one thing that held the organization together beyond all others was the publication with the mother love, erecting a monument, behind it. In 1886 the publication fund was begun with a gift from Charles Viele, of Evansville, Indiana, of fifty dollars. From that time the idea of keep-

ing the Proceedings alive was foremost in mind. Mrs. Putnam exercised every energy to secure the funds. The curatorship had passed from Prof. Pratt to Prof. Barris, whose important papers on local geology are a valuable part of the Proceedings. Leaving to him all the curator's duties and more, she devoted herself to this. In 1895 she saw her desires gained: a bequest of ten thousand dollars was left in that year by Mrs. Mary P. Bull as a permanent publication fund, a memorial to Charles E. and J. Duncan Putnam.

With this substantial encouragement the academy now looks forward with increasing hope. Much needed improvements have just been made in building and cases; books have been rearranged in the library; much needed binding of pamphlets and magazines has been done. The membership is increasing, and when the faithful few long toilers are gone new recruits will be ready. Definite plans of growth and development are shaping themselves. An effort is making to raise the *permanent endowment fund* to fifty thousand dollars. When that is done a paid secretaryship can be established to direct and organize the work. Then, with permanent publication secured and direction and activity insured, an effort will be made to complete the building. The edifice already constructed is only the rear part of a far more extensive one. On the lot before it is ample space for a large and imposing structure. The present building is of brick, and is in two stories. The dimensions are shown on the accompanying ground plans. The front door opens on a central hallway, on either side of which is a small, square room. One of these is the office and workroom of the curator; the other contains the *Putnam entomological collection and library*, and is used for the regular monthly meetings of the academy. Behind these rooms is the main museum hall. It consists of a ground floor, with a second-story gallery running around its four sides. On the main floor are the collections in natural history, representing all departments, and particularly rich in local zoölogy and geology. Here are the results of the field work of Sheldon, Pratt, Barris, and

FIG. 12.—CHARLES E. PUTNAM.

Pilsbry, not to mention many other local collectors. Here are Captain Hall's collections from Arkansas, and the tablets, pipes, copper axes, and other notable specimens from the local mounds.

FIG. 13.—W. H. PRATT.

In the gallery are collections of minerals and an extensive series of stone-age tools and weapons. In front of this gallery and over the hallway and two front rooms of the lower story is the library, which can be used as a hall for a reasonably large audience. The library is one of the best devoted to science in the West, and has been chiefly secured in exchange for the Proceedings. Nominally it contains more than forty thousand volumes; but this number must be considerably reduced, as latterly single issues of periodicals have been catalogued under distinct numbers. With all reductions made, however, the library is important. Publications in twenty-two different tongues are on its exchange list.

Among the most recent subjects in which the academy has interested itself is an archæological study of the State of Iowa, planned by the writer. The plan involves several distinct pieces of work:

1. The preparation of a *bibliography* of Iowa antiquities.
2. The publication of a *summary* of Iowa archæology.
3. Organization of field work throughout the State.
4. Publication of a final report and an archæological map.
5. Preparation of a series of diagrams and casts of an educational character for distribution to the higher institutions of learning in the State.

The first two parts of the plan have been accomplished, and the academy is now endeavoring to carry out the third. While the academy has given and is giving considerable attention to archæology, it is not neglecting other lines of science, and papers of importance in geology, botany, and entomology are in its hands for publication in the near future.

Thirty years is not a long time, even in America. In December, 1897, the academy will celebrate its thirtieth anniversary by a special meeting. It may then look back with pride over its record. From a membership of four meeting in an office, it has grown

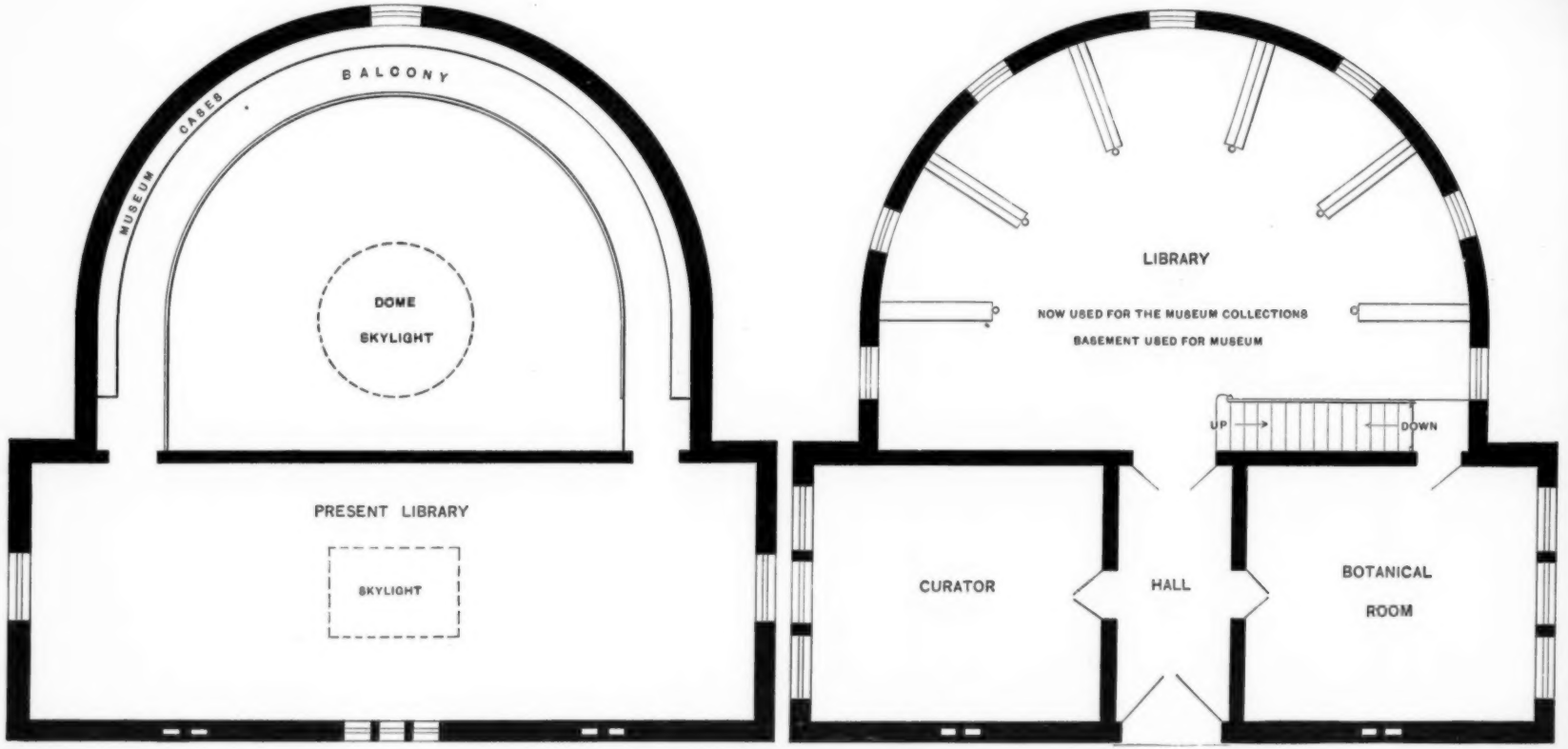

FIG. 14.—GROUND PLAN OF ACADEMY BUILDING.

to one of scores meeting in its own home; it has a neat building free of debt; it pays a curator a regular, if small, salary; it has something toward a permanent endowment fund; with six creditable volumes of Proceedings, it has a permanent invested fund of ten thousand dollars to perpetuate their publication; it owns a valuable museum, which is open free to the public, and acts as a constant incentive to develop scientific interest. And all this has been done by the academy in a small town in the West, without the assistance of any particularly wealthy patrons.

SOURCES OF THE NEW PSYCHOLOGY.*

By E. W. SCRIPTURE,
YALE UNIVERSITY.

PSYCHOLOGY did not begin with the development of its own methods or in the psychological laboratory; on the contrary, it has been largely the product of other sciences. In most cases the first impulse to the investigation of psychological phenomena was given by the discovery of sources of error in the other sciences which were due to the scientist himself.

In astronomy Tycho Brahe did not accept his instruments as being correct, but determined their errors; it was not, however, until centuries later that a suspicion arose concerning the possibility of errors in the observer himself.

Astronomers have to record the time of the passage of heavenly bodies across parallel lines in the telescope. When the star is about to make its transit the astronomer begins counting the beats of the clock. As the star approaches and passes the line he fixes in mind its place at the last beat before crossing and its place at the first beat after. The position of the line in respect to these two places gives the fraction of a second at which the transit occurred.

In 1795 the British astronomer royal found that his assistant, working with another telescope at the same time, was making his records too late by half a second. Later on, this amounted to 0·8 second. This difference was large enough to seriously disturb the calculations, and, as the astronomer did not suspect that he himself might be wrong, the blame was laid on the assistant.† In 1820 Bessel‡ systematically compared his observations with

* From a forthcoming work, The New Psychology (London, Walter Scott; New York, Scribner).

† Greenwich Astronomical Observations, 1795, vol. iii, pp. 319, 339.

‡ Astronom. Beobacht. d. Sternwarte zu Königsberg, Abth. VIII, p. iii; Abth. XI, p. iv; Abth. XVIII, p. iii.

those of another observer for the same star. They found a difference of half a second. Later he made similar experiments with Argelander and Struve, with the result of always finding a personal difference.

Bessel sought for the cause of this "personal equation" by varying the conditions. He first made use of the sudden disappearance or reappearance of a star instead of steady motion. The personal difference was much decreased. This seemed to indicate that the trouble lay in comparing the steady progress of the star with the sudden beat of the clock. The next step was to change the beats, with the result that for Bessel the observations were made later with the clock beating half seconds than with one beating seconds, whereas Argelander and Struve showed no particular change. One other point was investigated—namely, the effect of the apparent rate of the star; within wide limits the personal equation was not changed.

About 1838 the personal equation began to receive regular notice in astronomical observations, as appears in the publications of Airy * and Gerling of that year.†

It was natural to wish for a comparison of the astronomer's record with the real time of transit. At the suggestion of Gauss, an artificial transit was arranged by Gerling, the object observed being a slow pendulum. This is probably the first measurement of a reaction time. In 1854 Prazmowski ‡ suggested an apparatus carrying a luminous point for a star and closing an electric circuit at the instant it passed the line; a comparison of the true time with the astronomer's record would give the real amount of his personal equation. From this time onward various forms of apparatus were invented and numerous investigations were carried out. The astronomers found that in such observations sometimes the star was seen to pass the line too soon, sometimes too late, and that the error varied with every variation in the method of observing and in the mental condition of the observer.*

Let us turn for a moment to another science. The new physiology, begun by the pupils of Johannes Müller, in which the phenomena of life were to be explained by physical and chemical processes, had undergone a remarkable development. Du Bois-Reymond had taught how to apply the experimental methods and apparatus of physics to the study of physiological processes. Soon after this Helmholtz measured the velocity of nervous transmission (1850), an experiment that Johannes Müller had

* Greenwich Astron. Observations, 1838, p. xiii.

† Astron. Nachrichten, 1838, vol. xv, p. 249.

‡ Comptes rendus, 1854, vol. xxxviii, p. 748.

* For the history of the personal equation, see Sanford, Personal Equation, Am. Jour. Psych., 1888, vol. ii, pp. 3, 271, 403.

considered hopeless. This involved the construction of the myograph and the application of Pouillet's method of measuring small intervals of time.

The nerves, however, are only the peripheral portions of the nervous system; the desire lay near to measure the time occupied by the brain processes. Such measurements have been (and still are at the present day) impossible by direct physiological methods. It was, however, a sufficiently settled fact that the brain processes are closely accompanied by mental processes. This consideration led to the employment of the time-methods on living human beings. The stimulus was applied to the skin, to the eye, or to the ear, and the time required for the subject to respond by a muscular movement was measured. Since the subject could tell what he experienced under different variations of the experiment it was found possible to measure the time of sensation, of action, etc. The physiological processes corresponding to these mental processes were to some extent known. It was soon discovered, however, that other mental processes—e. g., discrimination, association, etc.—could be introduced in such a way as to be measured.

Beginning with 1865, Donders made a systematic attack on the problem of psychological time-measurements, and was soon followed by Exner. Helmholtz had already directed the experiments of his pupil Exner in measuring the time of sensation, and in 1877 the work of Auerbach and von Kries appeared from his Berlin laboratory.

The interest of the physiologist lay, however, mainly in the deductions to be drawn concerning brain action. Even from the simpler forms of reaction time the amount of physiological knowledge to be obtained is small, and for the more complicated forms it is zero. It was natural, therefore, for physiology to pursue the subject not much further.*

Thus the two sciences of astronomy and physiology discovered and developed the methods of investigating mental times; the further development was the task of psychology.

Another source of the new psychology is to be found in the physiological study of the sense organs. The most obvious method for determining the functions of the nerves and end organs of the skin—the nose, the ear, or the eye—is to ask the living subject what he feels when various stimuli are applied. In this way there has arisen a large body of knowledge concerning the sensory functions of the nervous system. In this form, however, the problem is a purely psychological one. To inquire if the skin

* For the historical account of experiments on reaction time, see Buccola, La legge del tempo nei fenomeni del pensiero, Milano, 1883, and Ribot, La Psychologie allemande contemporaine, Paris, 1885; for a summary, with literature, see Jastrow, Time Relations of Mental Phenomena, New York, 1890.

"feels" heat is, from a physiological point of view, an indirect question. Physiologically, the nerves of the skin may respond to heat by some chemical process; that they do so respond may be inferred on the hypothesis of a correspondence between the occurrence of a sensation of heat and the action of the nerve. The direct question is one of psychology; it is asked by physiology for its own purposes, and the psychological data are collected as long as they are of use in this way. Physiology, however, is "physics and chemistry of the body," and as soon as psychological data cease to afford physical deductions the interest of the physiologist generally ceases. The study of the psychology of sensation and action, however, has formed and still forms an important portion of physiology.

Historically considered, the study of the sensations of the skin received its first great impulse from Ernst Heinrich Weber's monograph, *Tastsinn und Gemeingefühle.** This has been followed by the work of a host of investigators from the laboratories of Ludwig, Du Bois-Reymond, and their pupils.†

The physiology of the eye originated much of the psychology of sight. Concerning the functions of the optical system, physiology can scarcely be said to have gone beyond the dioptrics of the eye. Nearly all further knowledge consists of deductions from the mental experiences of the subject. For example, physiology knows almost nothing concerning the functions of the retina. Psychologically, however, the color sensations and their combinations can be accurately measured. It is true that the investigations of color vision have been and are mainly carried out by physiologists and physicists; but the point of view has become primarily a purely psychological one. This is strikingly exemplified in the researches of König, from which physiological deductions are practically excluded. For the various other phenomena, such as those of the optical illusions, of monocular and of binocular space, we have at present no hope of anything beyond a psychological knowledge, and the investigations of Hering, Helmholtz, and others can be regarded as direct contributions to psychology.

There is a third science whose influence is to-day the strongest of all. Physics is theoretically the co-ordinate science to psychology. Every direct experience has an objective, or physical, and a subjective, or psychical, side. Again, the fundamental science of Nature is physics, that of Mind is psychology. Practically, however, psychology receives from the most powerful science

* Wagner's Handwörterbuch d. Physiologie, 1851, vol. iii (2), p. 561; also separate.

† For summaries and references, see Funke und Hering, Physiologie der Hautempfindungen und der Gemeingefühle, Herrman's Handbuch der Physiologie, 1880, vol. iii (2), p. 287; and Beaunis, Nouveaux éléments de physiologie humaine, vol. ii, Paris, 1888.

of modern times an invaluable protection and an uninterrupted series of scientific gifts. The photometry of Lambert led not only to the methods of modern technical photometry but also to the measurement of our sensations of light, while the law of relativity of sensations had been—before Fechner—established for lights by Bouguer, Masson, Arago, Herschel, and Steinheil. The study of the errors of observation in physics and astronomy has led not only to the science of physical measurements, but also to that of psychological measurements. Newton, Young, and Maxwell began not only the science of ether vibrations, but also the science of sensations of color. The laws of mechanics apply not only to inanimate objects but also to the results of our own volitions. In fact, in every department of psychology, progress has been and still is closely dependent on the achievements of physics and technology.

Psychology has not only received most of its methods and much of its material from physics; it has for the first time in history reached through physics a definite conception of its own problem. The older psychology and philosophy had always maintained the necessity of directly investigating the facts of consciousness. The standpoint was simple enough, but, as no scientific methods of doing so were developed, the whole problem remained vague and unsatisfactory. Among the proposals for a better state of affairs was that of first investigating the nervous system and then deducing psychological laws therefrom. The brain was to be accurately mapped out into faculties, the paths of nervous currents were to be traced along various fibers, and the interaction of nervous molecules was to be known in every particular; it was even expected that various cells could be cut out, with a memory or a volition snugly inclosed in each. In other words, there was to be no psychology except on the basis of a fully developed brain physiology. Unfortunately, very little has been ascertainable concerning the finer functions of the nervous system. Aside from a general knowledge that the cerebellum has to do with co-ordination of movements, the convolutions of Broca have to do with speech, and similar facts, nothing of even the remotest *psychological* bearings has been discovered concerning the functions of the brain. The roseate hopes of those who expected a new psychology out of a "physiology of mind" were totally disappointed. In the effort for something new, however, the psychologist supplied the data concerning the "molecular movements" in the brain out of his own imagination; the familiar facts of mind were retold in a metaphorical language of "nerve currents," "chemical transformation," etc., of which not one particle had a foundation in fact. The physiology of mind started with an impossibility and ended with an absurdity.

It is to be noted that these statements refer to investigations of and speculations on the brain for *psychological* purposes. For physiological purposes the case is utterly different. The development of brain anatomy and of the knowledge concerning the localization of cerebral functions are among the greatest achievements of modern times.*

Moreover, the collection of facts and the development of theories of the nervous activities accompanying mental phenomena has given rise to the science of physiological psychology.†

With these sciences, however, the psychologist has comparatively little to do. The study of brain function has not contributed a single fact to our knowledge of mental life; the deductions of physiological psychology concerning nervous function have begun with the facts of experimental and observational psychology, and are still so unsettled as not to allow additional deductions backward.

While this was going on, physics had through Helmholtz,‡ Mach,* and others gradually come to a clear understanding of the relation of its facts to the immediate facts of consciousness. Direct experience as present in our sensations was accepted as supplying the facts of physics. For example, in measuring the length of a bar, a visual sensation, the scale of measurement, was applied to another visual sensation, the bar. Indeed, as was clearly recognized, every direct measurement of physics was primarily a comparison between sensations—in other words, a psychological measurement. From this combined measurement the physicist reduced as much as possible the psychological elements; it was but a step for the psychologist to reduce the physical elements in order to have a psychological measurement.‖ This step made psychology for the first time a science in the

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* For a historical sketch and an account of the latest remarkable discovery, see Flechsig, Gehirn und Seele, Leipzig, 1896.

† As a representative work see Exner, Entwurf zu einer physiologischen Erklärung der psychischen Erscheinungen, i. Theil, Lepzig, 1894. For a convenient summary see Ziehen, Leitfaden der physiologischen Psychologie, second edition, 1893, also translated.

‡ Helmholtz, Ueber das Ziel und die Fortschritte der Naturwissenschaft, Populäre wiss. Vorträge, Braunschweig, 1871. Helmholtz, Die Thatsachen in der Wahrnehmung, Leipzig, 1879.

* Mach, Die Mechanik in ihrer Entwickelung, Leipzig, 1883, second edition, 1889; also translated into English, Chicago, 1895 (Mach's earlier monographs are mentioned in the preface). Mach, Beiträge zur Analyse der Empfindungen, p. 141, Jena, 1886.

‖ The psychological standpoint has been clearly stated by Wundt, Ueber die Messungen psychischer Vorgänge, Philos. Studien, 1883, vol. iv, p. 1; Weitere Bemerkungen über psychische Messungen, Philos. Studien, p. 463; Ueber die Entheilung der Wissenschaften, Philos. Studien, 1889, vol. v, p. 1; Ueber die Definition der Psychologie, Philos. Studien, 1896, vol. xii, p. 1; Ueber naiven und kritischen Realismus, Philos. Studien, 1896, vol. xii, p. 307. I have followed Wundt in The Problem of Psychology, Mind, 1891, vol. xvi, p. 305; Psychological Measurements, Philosophical Review, 1893, vol. ii, p. 677.

full meaning of the term, with all the previous achievements of physics for its use.

With a real science of the facts of consciousness at hand, the attempt at a "mental physiology" appears as absurd as an attempt to establish a science of meteorology from the twitterings of the birds—especially when the birds are imaginary ones. The physicists have thus not only given to the new psychology its basis, but have also freed it from the rubbish of an overheated imagination.

There is still another source which we must consider, namely, the old psychology. By the "old psychology" we mean psychology before the introduction of experiment and measurement; in its last forms it is the psychology of the Herbartians or of the English associationalists.

We have already seen how the fundamental method, that of observation, was established by the old psychology. The method of direct observation of mental life is the only possible one, and until it had received a firm basis any science of psychology was impossible. As has been explained in Part I, all the other methods of psychology are only refinements of this method. The new psychology is thus merely a development on the basis of the old; there is no difference in its material, no change in its point of view, and no degeneration in its aim. What the old tried to do, namely, to establish a science of mind, and what it did do, as far as its means allowed, the new psychology with vastly improved methods and facilities is striving to accomplish.

This close connection, however, must not involve us in a false estimation of the direct results accomplished by the old psychology. The method of unaided observation was applied to exhaustion, and the later works contained little more than the earlier ones. Indeed, the final sum total of psychological knowledge acquired by this method can be stated to be a mass of ingenious speculations, of endless discussions, and of true and untrue facts; even such achievements as the laws of association have, in the light of newer methods, been shown to be merely superficial arrangements of facts. It has been claimed that unaided observation has yielded valuable storehouses of facts, and it furnishes a special satisfaction to some people at the present day to point out guesses of this older psychology forestalling achievements of the newer science. Among the clever observations concerning facts of mental life and the ingenious guesses at their laws, there are and must be some which are ultimately found to be partially or wholly correct. As Helmholtz remarks: "It would be a stroke of skill *always* to guess falsely. In such a happy chance a man can loudly claim his priority for the discovery; if otherwise, a lucky oblivion conceals the false conclu-

sions. The adherents of such a process are glad to certify the value of a first thought. Conscientious workers, who are shy at bringing their thoughts before the public until they have tested them in all directions, solved all doubts, and have firmly established the proof; these are at a decided disadvantage. To settle the present kind of questions of priority only by the date of their first publication, and without considering the ripeness of the research, has seriously favored this mischief.

"In the type-case of the printer all the wisdom of the world is contained which has been or can be discovered; it is only requisite to know how the letters are to be arranged. So, also, in the hundreds of books and pamphlets which are every year published about ether, the structure of atoms, the theory of perception, as well as on the nature of the asthenic fever and carcinoma, all the most refined shades of possible hypotheses are exhausted, and among these there must necessarily be many fragments of the correct theory. But who knows how to find them?

"I insist upon this in order to make clear to you that all this literature, of untried and unconfirmed hypotheses, has no value in the progress of science. On the contrary, the few sound ideas which they may contain are concealed by the rubbish of the rest; and one who wants to publish something really new—facts—sees himself open to the danger of countless claims of priority unless he is prepared to waste time and power in reading beforehand a quantity of absolutely useless books, and to destroy his reader's patience by a multitude of useless quotations."*

In order to give a psychological illustration, I will refer to the case of mediate association of ideas.† The existence of such associations was discovered in the course of an extended experimental investigation of the manner in which ideas were associated. It was proved, for the first time, that such associations are made. A single personal observation of this sort is to be found in Hamilton's works. A still earlier one is reported from Hume, and a favorable perusal of the works of Aristotle would probably reveal something similar. Such cursory observations, fruitless and unconfirmed, do not entitle the makers to any special credit. The credit of an experimental discovery remains with the discoverer, regardless of previous guesses that may have hit the truth.

The debt of the new psychology to the old psychology of the past does not involve any claims by the "sensation-psychology" of the present. Among the pupils of the old psychology there

* Helmholtz, Popular Lectures, Second Series, p. 228. New York, 1881.

† The idea, C, follows a totally unrelated idea, A. A and C had previously been independently associated with B, but now B is not thought of, or is entirely forgotten.

were necessarily many who grew up in ignorance of the new, or who did not learn of its existence until too late for changing the mode of thought. Just as the old psychology led to an improved science on the part of the progressive men, so it led to a degenerated form on the part of the others. Unable to grasp and to apply the methods of true science, these men can not even understand what the new is all about; and in their attempt to do something new they have fallen into the absurdities of "psychical research," or "experimented" with spiritualistic mediums, or gathered "statistics" concerning ghosts, or interviewed the several personalities of the hypnotic subject.

The older psychology, with its traditions and its dignity, was a discipline to be treated with filial consideration and respect; but the latest "sensation-psychology," plunged in the dregs of all the mysticism and superstition of the middle ages, not only contributes nothing to the progress of science, but arouses in opposition to it all the ghosts of the witches' caldron.

Summarizing, we are entitled to say that the new psychology is the old psychology in a new phase of development; that the impulses to this development came from physics, physiology, and astronomy; and that the resulting application of the best methods of modern science to the great problems handed down from the past is what makes the new psychology a true science worthy of its origin.

THE LATENT VITALITY OF SEEDS.

By M. C. de CANDOLLE.

SEEDS that remain in keeping without losing the faculty of germination are said to be in a state of latent life. The term is not exact, for it leaves us still to ask whether the life of the seeds is completely stopped, or is simply slackened in its activity —questions to which the same answer can not be given under all circumstances. It may be that a seed will continue to respire without producing any formation of new histological elements, when a loss of substance results to the plantule it contains which is compensated for by the assimilation of reserve materials from the *energides*, or living protoplasmic masses of the cells. A plantule may be supposed to live in this way for a considerable time if the temperature is favorable and the seed and the surrounding air are not too dry. Under these conditions the latent life may be considered one of slackened activity.

An experiment by MM. Van Tieghem and Bonnier proves that seeds may retain their vitality for a considerable period in this condition. Three lots of peas and beans were left—one in

the open air, a second in a sealed glass tube containing common air, and a third in a sealed tube containing pure carbonic-acid gas. At the end of two years the seeds of the first lot had perceptibly increased in weight, and nearly all germinated; those kept in confined air had increased less in weight, and fewer of them germinated; the air inclosed with them in the tube had changed in composition, having lost oxygen and gained carbonic acid. Of those sealed up in carbonic acid, the weight had not changed, and none germinated.

While these results show that the seeds continued to lead a retarded life in open and in confined air, it is possible that the retarded life was only of short duration, and that it had ceased, before the end of the experiment, to give place to a complete stoppage of respiration, assimilation, and life. But to admit this we have to suppose that the protoplasm in seeds in latent life finally becomes wholly inert, while it preserves its composition and its internal chemical structure. This view seems to be confirmed by a number of experiments and observations which I am about to describe.

I have already several times related experiments that prove that seeds may be subjected to a very intense cold for many hours in succession without losing their germinating faculty. A recent experiment of this sort, made with M. Raoul Pictet's apparatus and under his direction, proves that some peas and beans and fennel seeds germinate quite well after having endured for four days a temperature of — 200° C. (— 328° F.). The seeds had not undergone any previous desiccation, and no precautions were taken to adjust the depression of temperature. Others of M. Pictet's researches have demonstrated that the chemical reactions which take place at ordinary temperatures cease to be produced at very low temperatures, like those reached in the experiments just mentioned. If this is so, we may suppose that the protoplasm of seeds exists during these experiments in a condition of complete inertia, without either respiring or assimilating. In other words, life is then really stopped; yet this does not prevent their vegetating anew when the conditions of temperature and moisture permit it. The seeds in these experiments were cooled so very rapidly that it is natural to suppose that their protoplasm was already quite inert before the test began. It would be hard otherwise to explain its complete indifference to abrupt variations of temperature, which would certainly have been more harmful if they affected protoplasm still active.

Another experiment I have recently tried casts more light on this point. Wrapping seeds of wheat, oats, fennel, and the sensitive plant in packages of tinned paper and inclosing the whole in a sheet-iron box, hermetically sealed, I placed them under the

cover of a wooden box in a compressed-air refrigerator for meats, where they were exposed for a hundred and eighteen days to repeated but not continuous refrigerations, most of which lasted twenty hours each. The lowest temperature reached was — 53·89° C. (— 65° F.); the highest, — 37·78° C. (— 36° F.); and the mean, — 41·93° C. (— 43·4° F.). After each refrigeration the temperature rose to that of the interior of the receiver, but slowly, while the refrigerations were rapid.

After the conclusion of the experiment, when taken out of the refrigerator and planted, the wheat, oats, and fennel came up promptly; only thirteen out of sixty seeds of sensitive plants germinated, and of lobelia seeds, which were too small to be counted, only ten. The failures of the sensitive-plant seeds could not all be attributed to the cold, for others of the same species which were not refrigerated did but little better. The lobelia seeds were, however, certainly killed by the cold, for the control seeds germinated abundantly. It is safe, too, to infer that seeds can remain inert and unharmed in a medium unsuitable for respiration, provided nothing is present to injure their protoplasm through chemical action. Such a medium, for example, would be an atmosphere of carbonic acid.

I desired to ascertain the effects on germination of keeping seeds in vacuum. The most obvious way of trying this experiment, by the formation of a barometrical vacuum, was liable to the objection that the abrupt removal of the air and moisture might disturb the tissues and modify the structure and composition of the protoplasm of the seeds, and thereby produce a complication of results. I therefore tried another way, by immersing them in mercury under such precautions that no air could reach them other than what they contained within themselves. The results agreed substantially with those obtained by refrigeration, and go to confirm the view that seeds can continue to subsist in a condition of complete vital inertia, from which they recover whenever the conditions of the surrounding medium permit their *energides*, or the living masses of their cells, to respire and assimilate.

At first sight, this return to life resembles the resumption of motion by a machine that has been resting when it is put into communication with its motor—a comparison which has been often made. But the phenomena are not of the same nature in the two cases, and the *energides*, of which the total constitutes the living individual, are not machines in the usual sense of the word. For a machine works without changing its structure, while the *energides* segmentate after they have grown, and their segmentations operate in their turn as *energides*. This is because the matter assimilated by living protoplasm augments its mass

without diminishing its energy. For it to be so, this mass must evidently continually receive new portions of energy, and this can come only either from the surrounding medium or from the reactions that go on in the protoplasm itself. In the former case the agency consists of radiations of different sorts, and is of a purely physico-chemical order; while this can not be in the second case. In fact, the life of protoplasm is manifested by movements which are combined in such a way as to produce an orientation of its parts according to certain structural dispositions succeeding one another in a determined order; phenomena to which ordinary physico-chemical actions never give rise. We are therefore necessarily led to suppose the existence of a special class of reactions of which assimilated matters become capable only after their absorption into this special medium, living and pre-existing protoplasm, into which they penetrate.

Under this relation we might, in a certain way, compare assimilation to what occurs when combustible matter takes fire on being heated in a furnace in which a combustion is already going on, and is kept up by the new matter. So, one might say, it is only after having been previously put into a special condition by their mixture with protoplasm that assimilable substances react among themselves in such a way as to produce a new quantity of living matter. So one may suppose that protoplasm in the condition of latent life, having become inert but retaining the faculty of reviving, resembles those mixtures formed of substances that do not react except under certain conditions of temperature or other influences, and which, so long as those conditions are not fulfilled, continue indefinitely in contact without combining. Such, for example, are explosive mixtures.

The presence of assimilable matter in protoplasm or within its range is not sufficient for the production of the phenomena of assimilation and orientation. Certain conditions of temperature, moisture, and aëration have to be realized. As long as they are not realized, and if nothing occurs to change the composition or structure of the *energides*, they will remain inert, while they retain the faculty of evolving anew when the circumstances become favorable again.

Such condition of chemical and vital inertia may probably endure for a long time, possibly indefinitely. This, as it seems to me, is at least the only way of accounting for the preservation of seeds during very many years. Cases are in fact known where seeds have germinated after so prolonged a rest that it is impossible to assume that they have lived during the interval even a retarded life. We cite a few examples. M. A. P. de Candolle *

* Physiologie, p. 621.

speaks of seeds of the sensitive plant that germinated after more than sixty years of rest. Girardin * saw beans germinate that were taken from Tournefort's herbarium, where they had been kept more than a hundred years.

In 1850 Robert Brown, out of curiosity, sowed some seeds from the collection of Sir Hans Sloane, of which they had formed a part for more than a hundred and fifty years. He succeeded in making several of them germinate, particularly a seed of *Nelumbium speciosum*. The plant has been preserved in the galleries of the British Museum,† where I saw it a few years ago.

The pretended germination of wheat from mummies is said to be a fable. It seems, besides, that wheat was always sterilized before being introduced into the sarcophagi, so that the possibility of its being brought to life again was excluded in advance. On the other hand, various well-verified facts have demonstrated that seeds may preserve their faculty of germinating after an extremely prolonged abode underground—that is, when sheltered from atmospheric influences. The most extraordinary case of this kind was observed a few years ago by Prof. de Heldereich,‡ director of the Botanical Garden at Athens. While herborizing around the mines of Laurium, this naturalist discovered, in 1875, a *glaucium*, which he unhesitatingly considered a new species, and described under the name of *Glaucium serpieri*. The plant had just made its appearance on a tract from which had recently been removed a thick bed of scoria produced in the workings of the mines by the ancients, or at least fifteen hundred years ago. Unless we assume a spontaneous generation, this *glaucium* must be regarded as a species which existed formerly in the place, the seeds of which had been preserved intact under the protection of the ground and the scoria that covered them.

Many instances are mentioned in which the opening of deep trenches or the clearing of forests has been followed by the appearance of species formerly unknown in the place. Prof. Peter, of Göttingen,# has very recently made a long series of methodical researches, the results of which are of great interest. His method consists in collecting specimens of forest earth, the age and all the anterior conditions of which are fully known. He cultivates them, taking all precautions against introducing foreign seeds. These specimens of earth are always taken from

* Sur la propriété qu'ont certaines espèces de graines de conserver longtemps leurs vertues germinatives.

† See Gartenflora, 1873, p. 323.

‡ These facts have been recently confirmed by Mr. W. Carruthers, director of the botanical galleries in the British Museum.

Nachrichten v. d. königl. Gesellschaft der Wissenschaften u. d. Georg-Augustus Universität zu Göttingen, November, 1893, and December, 1894.

thickly shaded spots, destitute of all other vegetation except the moss that carpets the surface of the soil. Holes are dug under this moss, from which the earth is taken at depths successively of eight, sixteen, and twenty-four centimetres. The specimens taken from these several depths are cultivated separately. The cultivations, prolonged for more than three months, have all ultimately given rise to plants the seeds of which must of necessity have remained under the earth for a greater or less length of time.

M. Peter has carefully indicated in detail the plants that corresponded to each of the specimens of earth on which he operated. It resulted from the experiments that the specimens of earth from very old forests gave plants of the woods, while those from forests of more recent date yielded species the nature of which was manifestly related to the previous disposition of the soil—that is, plants of the fields or the meadows, according as forestation had replaced one or the other of these methods of cultivation. While he is extremely reserved as to the probable duration of the abode of the seeds in the soil, M. Peter concludes in these words: "Although the experiments in cultivation just described do not furnish a solution to the question of the length of time during which seeds at rest preserve their faculty of germinating, the conclusion results from this demonstration that for many field and meadow plants this duration may considerably exceed a half century."

These researches of M. Peter's deserve careful attention, and it is to be hoped that they will, without delay, be imitated in other countries and different kinds of land, for they may reveal very important facts in biology and prehistoric botanical geography. Alphonse de Candolle* insisted a few years ago on the desirability of making soundings beneath the snows of the Alps with a view of recovering vestiges of the vegetation anterior to the Glacial period. It is to be regretted that no one has carried out this idea, for the facts I have just summarized almost permit us to hope that research of this kind may lead to the recovery of still vital seeds dating from very remote epochs.—*Translated for the Popular Science Monthly from the Revue Scientifique.*

THE managers of the Cornell University Experiment Station Extension Work are able to draw comfort even from seemingly the most unpropitious conditions. They represent that they have been greatly aided in their mission of extending the knowledge of plain facts and enforcing their meaning "by the hard times and multitudes of bugs and special difficulties. These things have driven people to thinking and to asking for information."

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* Extract from the Archives des Sciences physiques et naturelles.

STRANGE PERSONIFICATIONS.

By M. TH. FLOURNOY.

WHILE cases of colored audition and visual schemes are quite frequent, we have fewer instances of that special kind of synopsy which I call *personification*, because it consists, in its typical form, in the concrete representation of a personage —sometimes of an animal or a thing—being regularly awakened by a word that has no comprehensible relation with its curious associate. This sort of personification in its marked degrees is rare, and in the few instances that have come under my knowledge has been applied to the days of the week.

In M. E. F——, student in letters, nineteen years old, the figures of persons of very definite pose and occupation are provoked by various suggestions; among others, by those of the days of the week. Monday and Tuesday are to him a young man of serious aspect, with his forefinger on his eye—dark weather. Wednesday is a young man in the act of stealing something behind him, stooping down and putting his arms between his legs to take it. M. F—— does not see what this man takes, and does not know what it is; dark weather. Thursday is a man turning the knob of the kitchen door to go through that room to the next one. Friday is a man selling something on a wagon, which he holds with his hands. The object is indistinct, and M. F—— does not know what it is, but in his mind the man is the Wednesday man, and is selling the thing he stole on that day. The weather is clear. Saturday is a man falling against a door and putting both hands forward to push himself back, falling again, and so on several times. He is doing this for amusement. Sunday is a man buttoning his cuffs, and the weather is fine.

It will be seen that in respect to their psychological nature these personifications are a triple mixture of visual representations, of interpretative ideas (the idea of Wednesday's man stealing an object which is the same unknown thing that he sells on Friday, etc.), and of general impressions corresponding with the weather that is prevailing—except Thursday and Saturday, which have no weather assigned to them. The visual representatives of mental images do not take on the character of hallucinations, but remain simple mental images. These personages have no color, and their dress is extremely indefinite, but their figures are very sharply defined. M. F—— distinguishes all these details, and perceives clearly the expression, which is always serious (with the exception of Wednesday, who laughs while he is stealing his object). The localization of these visual images is not less precise. The man of Monday, for example, appears to

M. F—— always outside of him, but very near—hardly a yard away; he is and always has been of the same size as he, from which he concludes that they have grown up together. The man of Wednesday and Friday, on the other hand, is always seen at a considerable distance—more than fifty yards.

M. F—— does not personify any figure or number, except 14, which represents itself to him as an accountant sitting at his desk, writing. Of the months and seasons, only autumn is personified, as the same sad-looking man with his finger on his eye who represents Monday and Tuesday.

Most of the common nouns are associated with personifications, or rather were; for the phenomena were formerly much more numerous and persistent than now. M. F—— does not recollect having ever had such visions for isolated syllables, articles, pronouns, and other words without special significance; yet, at an age when he knew nothing of the gender of words or of sex, the letters of the alphabet called up—some (A, B, C, D, etc.) the image of a pair of trousers, and others (as H, M, N, R, etc.) of a robe. Words of a positive significance invoked representations largely independent of their real sense. Bottle, for instance, invoked and still invokes the image of a large woman, laughing, sitting on a little backed bench, with a table in front of her, but no other suggestion of a bottle in the vision. *Shark* (*requin*) is personified in a large horse stationed near the subject and by the side of a load of hay.

These parasitical representations, grafted on the word and always accompanying it, were often considerable impediments to conversation and reading. Now, with a few exceptions—such as the days of the week, the figures of which are still very intense—the images do not rise in the course of conversation or of an interesting reading, but they appear readily enough on reflection or when the book is a dull one. The relations of the personification and of the real idea are reversed in this way: Formerly the induced representation preceded the thought of the proper meaning; now it comes after it or remains latent, except in a few instances—as, for example, shark, where the image of the load of hay and the horse appears before the idea of the fish. M. F—— believes that his personifications reached their greatest intensity in his childhood, when he was seven or eight years old, and that they have progressively diminished since he was twelve. He formerly thought that as a rule everybody had similar impressions, but he was met with surprise and ridicule when he spoke of them to others.

M. F—— can say nothing of the cause of these curious phenomena; he finds them as far back as his recollection can reach, almost unvarying in intensity and inexplicable. A very small

number permit glimpses into their origin; it is, for example, probable that habitual or verbal associations have had a part in suggesting the likeness of Sunday to a person buttoning his cuffs, and of Friday (*vendredi*) to a man selling (*qui vend*) something placed upon a *van*. The masculine or feminine character of the dress attributed to the letters seems to be suggested by the pronunciation (*b*, masculine; *m*, feminine, etc.). In like manner, the personification of the word *college* may be explained as a youth wearing a large white collar (*col*) turned back on his jacket as children's collars are. So the word cat (*chat*) brings up the image of a cat with a twist in its mouth, as if it were laughing, because, perhaps, M. F—— had an impediment in his speech in childhood which caused him to make a face when he tried to pronounce the letters *ch*. But, while M. F—— regards these explanations as very plausible, they are still only hypotheses to him; for he has no precise conviction, no sure recollection that such were indeed the causes of his inductions in these cases. The special incidents to which these speculations apply are relatively very few, and his speculations as a whole are entirely enigmatical.

Perhaps their origin will become a little less obscure if we make account of the exaggeration which follows a process in M. F—— that is familiar to us all in a lower degree. When we hear somebody we do not know spoken of, or when the author in a romance introduces a new character, we spontaneously form an idea of his appearance and moral qualities which is not exclusively based on what we are told of him, but in which our fancy involuntarily participates to a considerable extent. Yet this idea usually remains vague and indecisive till more ample information comes to it, susceptible of being modified and enriched according to the course of events. With M. F—— this fanciful anticipation of the facts operates with exceptional promptness, while the images it engenders are distinguished by a rare persistence. A proper name is enough to call up in him, without any known reason, a complete and precisely defined figure, which thenceforth continues so fast attached to the name that meeting with the person himself does not dissociate it. Thus, M. F—— conceived the two Coquelins, before he had seen them, by virtue of their identity of name, in exactly the same form and with identical heads. He was much surprised not to see me wearing the full black beard he had immediately given me the first time I was spoken of to him. I supposed the beard belonged to another person of his acquaintance whose name had some similarity in sound with mine; but he did not think this was the case, and could not give any explanation of the fact. He can not even tell whether it is the auditive perception of the name, or its appearance when written, or its articulation, or a mixture of all these that induces his personi-

fications. This shows how unknown and mysterious are those associations with which the creative activity of the imagination is fed, which a single word suffices to bring into play, and of which a notorious consequence is the well-known importance attached by novelists to the choice of names for their heroes.

The rapidity of the evocation of the images and their tenacity when they are once formed appear especially marked in the ideas M. F—— conceives of the characters in a book. From the first two or three lines relative to a character he sees him rise in his mental vision, often very different from the description given by the author. A person described as blond, for example, appears brown to him. The representation, however, persists firmly, and the reading of the story does not modify it. No matter if the little girl of the first pages does grow and change her character in the course of the volume—she always continues to him the little girl of the beginning. When he reads the book a second time, after the lapse of a few months, the identical personifications appear again unchanged. It is not so with the pictures of places, likewise arbitrary and inexplicable, which M. F—— associates spontaneously with every scene he reads about, and also, in a smaller degree, with stories told him. These pictures, which are usually recollections of childhood without connection with the subject of the reading—a description of a mountain, for instance, suggests the recollection of a plain—have some degree of permanence in that they do not vary from one day to another during the time he is occupied with the book; but when he takes up the volume again some time afterward he finds that they have changed. He remembers very well on every occasion the image of the place which he had before, and finds that the story now calls out another. This variability of local images, in opposition to the fixedness of personations proper, points to their greater immediate dependence upon the subjective dispositions of the movement.*

These details seem to me, if not to exptain the inexhaustible phantasmagoria of M. F——'s personifications, at least to illustrate the special kind of imagination under the dominance of which they spring forth. This imagination is characterized by the union of two properties akin to those of sealing wax: great docility in receiving an impression at the right moment, and—that moment once past—an equal rigidity which opposes itself to any further modification of the impression. Novelty, emotional excitement, or a happy concourse of circumstances, accomplishes

* For analogous examples of curious evocatioms, but apparently inconstant, induced by reading or thought, see M. Pilo's Contributo allo studio dei fenomeni sinestesici. Belluno, 1894, pp. 7, 8.

here what heat does for sealing wax, and permits the fixation of the group of images, disordered as they may be, that burst out at the opportune moment. But while we can expose the wax again to the fire, these curious products of fancy do not bear remelting, and the ideas or the cerebral cells continue fixed in the fortuitous relations that were contracted at that privileged instant. How else can we account for associations so absurd and at the same time so persistent as that of a day of the week with a person stealing or selling some indefinite thing? We can not reconstitute the striking incident or the collection of unforeseen relations and subtle analogies which accomplished the soldering of two such heterogeneous things in M. F——'s mind; but it is supposable that the operation is effectuated at once, and that the initial plasticity was immediately spent; for the thing stolen and sold continues always indistinct, in spite of the natural curiosity which would ultimately have precisely identified it, if the activity of the imagination had retained the slightest hold upon it.

The same remark may be applied to the other incomprehensible details abundant in M. F——'s personifications. We might speak of fragments of dreams suddenly registered and riveted forever to the words which the caprices of the nocturnal imagination had momentarily brought into relations with them. The dissociation of words from their usual sense and their application to other images by virtue of a connection which the dreamer clearly feels and finds quite natural, but which vanishes on awakening to give place to the opposite feeling of complete incoherence, are in fact a frequent feature of dreams. In the personifications the images attached to the words independently and outside of their proper sense are nearly always as arbitrary as the dream, but permanent, and the connection is felt by the subject, although he himself knows that it is irrational and inexplicable.

The physiological conditions of this singular process are still unknown to us. No evidence of heredity has been brought to light in the particular case. Still, the fact that M. F—— has never met an echo in his family when he speaks of his impressions does not prove that his parents have not in their infancy experienced similar phenomena, which have disappeared and been forgotten in older life. — *Translated for the Popular Science Monthly from L'Année Psychologique.*

AN amusing story is told in his Notes from a Diary by Sir E. Grant Duff of the London Metaphysical Society, now defunct. It is to the effect that Sir John Simeon, after one of the society's early meetings, rushed up to one of the members and asked, with the appearance of great anxiety, "Well, is there a God?" "Oh, yes," was the reply, "we had a very good majority."

SKETCH OF JAMES NASMYTH.

JAMES NASMYTH was pre-eminently a self-made man. Though taught in the schools, he worked out his own way without regard to the teaching he had received, and by methods peculiarly his own. He was a master engineer, an astronomer whose discoveries and conclusions attracted the attention of learned societies and were admired by the great, and a successful manager of men. "There can be no doubt," says Nature, in a sketch of him, "that he stands in the front rank of those who have advanced the material interests of mankind by the application of science to industrial methods."

Mr. Nasmyth was born in Edinburgh, August 19, 1808, the next to the youngest child of a family of eleven, and died in London, May 7, 1890. He was the son of Alexander Nasmyth, an artist of considerable distinction, and reckoned in his ancestry two or three successive generations of architects and builders. Mention is made of his exercise of his observing powers in very early infancy. The conditions of his childhood life, although it was passed in the city, gave him opportunities to become acquainted with Nature. Many workshops were in operation near Calton Hill, where the nurses took the children to play, and he was one of the throng of little boys who were interested in watching the proceedings of the workmen. Having tools at home in his father's shop, he tried to imitate what he had seen done. He became skilled in making things for himself, and was called "a little Jack of all trades." He was taught by his eldest sister, then sent to a teacher of such a character that he contracted "a hatred against grammatical rules," and was enrolled in the Edinburgh High School in 1817. The teaching here was of the old routine sort, and aroused little interest in the pupil; but he did his tasks punctually and cheerfully, "though they were far from agreeable."

A different condition prevailed in the shop, where his father directed his attention to the action of the tools and to all the processes required for turning out the best work; and gradually he had planted in his mind "the great fundamental principles on which the practice of engineering in its grandest forms is based." Nasmyth became famous in the school for the perfect spinning tops, or "peeries," he could make, for his accurate construction of kites, and for his paper balloons. He cast, bored, and mounted small brass cannon, and made guns of cellar keys. With the fine steels he made he was able to buy the monitors off from the too strict enforcement of the assigned tasks. But he learned little of what the school taught—"a mere matter of rote and cram." He

formed intimacies with fellow-pupils that proved of value to him: with a youth whose father had a foundry, where he spent profitable hours, and with another whose father had a special genius for practical chemistry, and made colors and white lead; signals were arranged with this boy, so that when anything particular was going on at the laboratory Nasmyth was notified of it; and the boys made their own reagents, and acquired considerable skill in producing various substances.

Nasmyth left the high school at the end of 1820, not much the better for his small acquaintance with the dead languages, but the mathematical studies had developed his reasoning powers. He practiced accuracy in drawing, made his own tools and chemical apparatus, and interested himself in the volcanic geology of Edinburgh. He attended the Edinburgh School of Arts from 1821 to 1826, and at seventeen years of age he was constructing steam engines of different designs and for various purposes. He heard the lectures at the university on chemistry, geometry and mathematics, and natural philosophy. He established a brass foundry in his bedroom, but did his heavier work at George Douglas's foundry, for which he made an engine to drive the lathes, the operation of which had such an enlivening effect on the workmen that the proprietor affirmed that the output was nearly doubled for the same wages. He made an expansometer or instrument for measuring in bulk all metals and solid substances, which so pleased Dr. Brewster that he described and figured it in the Edinburgh Philosophical Journal. He experimented upon steam carriages for highways, and hit upon a device for increasing the draught of the engine chimney by the use of waste steam that George Stephenson had adopted, and which has given the locomotive its efficiency.

When it became possible, Nasmyth went to London to visit Henry Maudsley, the great manufacturer of machines, and seek employment in his establishment there. Maudsley's experience with pupil apprentices had not been pleasant, and he was not at first willing to employ him; but when the young man said he would consider himself fortunate if he could even be employed to clean the ashes from the furnaces, Maudsley answered, "So you are of that sort, are you?" and his heart was opened at once. Nasmyth exhibited his drawings the next day, and Maudsley instituted him his assistant workman, or private secretary, as no apprenticeship was needed in his case. His first work was on a machine for generating "original screws"; next, in connection with the construction of two small models of engines, he invented a device for exactly reducing bolt-nuts. Being given a month's vacation in the fall of 1830, he went to Liverpool to witness the performance of George Stephenson's locomotive, "The Rocket." With the desire to see all he could on his return of the mechan-

ical, architectural, and picturesque, he determined to walk leisurely back to London. He was impressed with the pretty surroundings of Manchester, especially as seen from the Patricroft Bridge; visited the cotton mills, and continued his walk to London, occupied with the thought of settling down in the busy neighborhood he had just left.

Mr. Maudsley died in February, 1831, and Mr. Nasmyth continued to work with his partner, Mr. Field, till the latter part of that year, when, in the twenty-third year of his age, he decided to go into business for himself. Mr. Field was pleased with his intention, and gave him facilities for starting. He went to Edinburgh and set up a small temporary shop, where he made himself a set of engineering tools. He subsequently chose Manchester as his permanent place of business. He found a shop in an eligible situation, with convenient appurtenances, but in a building occupied by other tenants. The time of his starting in Manchester was an auspicious one for his business. Workmen of all kinds were short of the demand, and, taking advantage of the scarcity, were disposed to be careless, irregular, and insubordinate, and machine tools, which would not get drunk or go on strike and were unfailingly regular and accurate, were in great request. Mr. Nasmyth got his full share of the work of supplying these tools: planing machines, slide laths, drilling, boring, and slotting machines, and others; and orders pouring in upon him, his flat became loaded with work. He having constructed an engine that was almost too large for the shop, one end of the beam, while it was being taken apart for shipment, crushed through the floor, disturbing the tenant below, and it had become evident that he needed a larger shop. He found a site within the very landscape that had attracted his attention years before, as he was resting at the Patricroft Bridge. He built there the celebrated Bridgewater Foundry, and took in Mr. Holbrook Gaskell as a partner. Observing the inconvenience and danger attending the operation of the foundry ladle then in use, he invented the screw safety ladle, with which, he says, some twelve or sixteen tons of molten iron could be decanted "with as much neatness and exactness as the pouring out of a glass of wine from a decanter."

The maxim of the Bridgewater Foundry, "Free trade in ability," was put in force early in its operation. By this maxim was meant promotion of the workmen according to the skill and activity they displayed, without regard to the kind of apprenticeship they had served. This conflicted with the rule of the trades unions, which required a seven years' apprenticeship, and the inevitable strike and picketing occurred. Workmen were brought from Scotland, the trades unions were conquered, and the foundry continued to practice and exemplify its maxim unmolested. The

practice was "to employ intelligent, well-conducted young lads, the sons of laborers or mechanics, and advance them by degrees according to their merits. They took charge of the smaller machine tools, by which the minor details of the machines in progress were brought into exact form. . . . A spirit of emulation was excited among them. They vied with each other in executing their work with precision. Those who excelled were paid an extra weekly wage. In course of time they took pride not only in the quantity but in the quality of their work, and in the long run became skillful mechanics. . . . The best of them remained in our service, because they knew our work and were pleased with their surroundings; while we, on our part, were always desirous of retaining the men we had trained, because we knew we could depend upon them."

The rapid extension of railroad construction, and the orders that consequently came in, led to much attention being given at Bridgewater to the building of locomotives, for which the machine tools used there gave great advantages. The Great Western Railway Company ordered twenty large engines, offering to add £100 to the contract price of each if they proved satisfactory. The premiums came, and with them a letter from the board of directors of the company offering to stand as references as to the quality of Messrs. Nasmyth and Gaskell's work. The Great Western Railway Company having successfully dispatched its steamship Great Western between Bristol and New York, and having elected to construct another steamer, the Great Britain, procured tools for making the engines from the Bridgewater Foundry. They were perplexed, however, about the forging of the intermediate paddle shaft, which was to be of a size never before attempted. They applied to Mr. Nasmyth, and he devised the steam hammer, the most famous of his inventions—an instrument with which, as he says in his autobiography, the workman might, "as it were, think in blows. He might deal them out on to the ponderous glowing mass and mold or knead it into the desired form as if it were a lump of clay; or pat it with gentle taps, according to his will, or at the desire of the forgeman." All was going well for setting the hammer in operation, when the plan of the vessel was changed by the introduction of the screw propeller, which rendered the immense shaft unnecessary. No patent was taken out for this invention, but the drawings of it were kept in the shop, open to the inspection of visitors. Among those who looked at them were M. Schneider, and M. Bourdon, his foreman, of the great iron works at Creuzot, France. A few years afterward, when Mr. Nasmyth visited Creuzot, he admired the excellence of a certain piece of machinery, and asked M. Bourdon how the crank had been forged. M. Bourdon

replied, "It was forged by your steam hammer." Mr. Nasmyth was then taken to the forge department, where he saw this "thumping child of his brain," which for him had existed only in his books, at work. The foreman had recollected the drawings, and embodied them substantially in the machine. Mr. Nasmyth at once secured a patent, introduced some improvements, and made the construction of the steam hammers a branch of his business. Though he was prompt enough in explaining to them the merits of his invention, it took considerable time to arouse the official minds of the Lords of the Admiralty, "who are very averse to introducing new methods of manufacture to the dockyards." But after he had furnished hammers to the principal manufacturers of England and had sent them abroad, these dignitaries learned in the course of three years that a new power in forging had been introduced. A deputation visited the foundry to see the invention, and were pleased and "astonished at its range, power, and docility." An order came for a hammer for the Devonport Dockyard. Their lordships were present when the hammer was started, and Mr. Nasmyth "passed it through its paces." He made it break an eggshell in a wineglass without injuring the glass. It was as neatly effected by the two-and-a-half-ton hammer as if it had been done with an egg spoon. Then "I had a great mass of hot iron swung out of the furnace by a crane and placed upon the anvil block. Down came the hammer on it with ponderous blows. My lords scattered and flew to the extremities of the workshop, for the splashes and sparks of hot metal flew about. I went on with the hurtling blows of the hammer and kneaded the mass of iron as if it had been clay." Orders followed to supply all the royal dockyards with a complete equipment of steam hammers.

The extension of the docks at Devonport called for an immense amount of pile driving. The contractor for the work had witnessed the operation of the steam hammer, and asked Mr. Nasmyth if the principle could not be applied to the pile driver. Such a pile driver was constructed. It was tested. Two piles of equal length and diameter were selected, one to be driven with the new machine and the other in the old way. The result was four minutes and a half with the former to twelve hours with the latter; and the steam-driven piles were hardly bruised, while the others suffered in the usual way.

Mr. Nasmyth had the satisfaction of seeing many of his mechanical notions adopted by rival or competing machine constructors, with or without acknowledgment. By the steady application of the rule of "free trade in ability" the factory was kept above trouble with the trades unions, being always able to find competent and interested hands to take the place of those who

might be disposed to go out on strike; and it was a source of the greatest pleasure to the proprietor, "when looking round the warehouses and factories, to see the intelligent, steady energy that pervaded every department, from the highest to the lowest." Other features of the Bridgewater factory were the manufacture of small engines for various purposes, in which a large business was done; the utilization of waste steam for heating and drying; improvements effected in calico-printing machinery; the furnishing of machine tools to the Woolwich Arsenal, which Mr. Nasmyth had found, when he inspected it, "better fitted for a museum of technical antiquity than for practical use in these days of rapid mechanical progress"; and the supply of rope-making machinery —a new line of work—to the Russian Naval Arsenal at Nikolaiev, on the Black Sea.

In 1854 Mr. Nasmyth took out a patent for puddling iron by means of steam, in which the superfluous carbon was removed by the oxygen arising from the decomposition of the steam. About a year afterward Mr. Bessemer brought out his invention for effecting the same purpose by a blast of air, and it totally eclipsed Mr. Nasmyth's process; but Mr. Nasmyth consoled himself with the thought that he was a kind of pioneer of the invention, and Mr. Bessemer offered him a third share of the interest in it. But Mr. Nasmyth "was just then taking down his signboard and leaving business," and thankfully declined the offer. He bought a place near Penshurst in Kent, and naming it Hammerfield, after his hammers and the family crest, retired to it in 1857, when he was forty-eight years old, and spent the rest of his life there.

Here he indulged himself with complete freedom in the study of astronomy, in which he had been engaged as an avocation for many years. He had made a very effective six-inch reflecting telescope as early as 1827, and had instructed Mr. Maudsley in the art three years later. He then made a speculum ten inches in diameter —composing the alloy himself—of such quality as evoked admiration from Mr. Lassell, and cast a thirteen-inch speculum for Mr. Warren de la Rue, whose interest in astronomy had been awakened by witnessing his processes. With his ten-inch telescope he began observations in a general way, which gradually became particular. In time he substituted for this a twenty-inch reflector with improvements that made it more convenient to use, and in 1842 began his systematic researches on the moon, making careful drawings in black and white of the features that attracted attention, and thereby training his eye for more accurate observation. A series of these drawings, with a large map of the whole visible surface of the moon, was first exhibited at the Edinburgh meeting of the British Association in 1850, and afterward at the Great Industrial Exhibition of 1851—where, besides a council

medal for his steam hammer, Mr. Nasmyth was given a complimentary notice for the lunar pictures—and to the Queen and Prince Consort personally. In the course of his astronomical observations he turned to consider the causes of the sun's light and other phenomena of light and heat. In May, 1851, he sent a communication to the Astronomical Society embodying his views that the light of the sun was simply the result of an action on that body of ethereal matter distributed through space unevenly, so that its intensity would vary as the system passed through different regions; that variability in stars might be thus accounted for; and that our Glacial period was produced by the solar system passing through a region deficient in power of luminosity. Mr. Nasmyth found afterward that these views were paralleled in some features of the theory of the sun enunciated by Dr. Siemens in 1882. He delivered a lecture on the Structure of the Lunar Surfaces before the Edinburgh Philosophical Society in 1858, and in 1874 brought out his book on The Moon considered as a Planet, a World, and a Satellite—a work which at once made its mark in selenological literature. He busied himself also with the study of the spots on the sun, and made the novel discovery of the willow-leaved structure of the solar surface, which attracted universal attention among astronomers. Sir John Herschel complimented him upon it in his Outlines of Astronomy; the astronomers at Greenwich made observations that confirmed it; and Father Secchi was trying to illustrate it by sprinkling rice grains over a blackboard covered with glue at the very moment Nasmyth was introduced to him by their fellow-astronomer Otto von Struve. We should mention, too, in connection with his astronomical studies the paper which he presented to the Royal Astronomical Society about 1851 on the Rotatory Movements of Celestial Bodies, which was suggested by the motion of that kind acquired by water running out of the bottom of a basin. Mr. Nasmyth was also interested in microscopy, and studied twenty-seven forms of infusoria in the water of the Bridgewater Canal; in photography, and made models of parts of the moon's surface and photographed them; in the origin of the form of the Pyramids, which he attributed to the appearance of the sun's rays streaming through clouds; and to the derivation of the cuneiform characters from the shapes of the impressions made by striking soft clay with the corner of a parallelogram-shaped instrument. He wrote Remarks on Tools and Machinery in Baker's Elements of Mechanics (1858).

Editor's Table.

SOCIAL NEEDS.

IF the word "socialist" could be defined as one who concerns himself with the interests of society, who makes those interests his own, then it would be well if we were all "socialists." So long, however, as it means a person who wishes to transfer to everybody the authoritative direction of everybody else's business and the control of everybody else's property, we must leave the use of the term to those who accept responsibility for the advocacy of such ideas. Meantime, it is a matter for the daily consideration of all men of good will what are the most pressing social needs of the hour, and how they can best be met.

Among the phenomena of our time in this country there is none, we think, more striking than the great development of our institutions of learning. Partly through public grants and partly through private donations, the means available for higher education have within the last quarter of a century, even within the last dozen years, been enormously increased; and, as has lately been remarked, there will shortly be little need for American youths to repair to foreign universities in order to obtain the latest and best results of research in almost any department of knowledge. In other words, this country is already well equipped for the formation of a cultured and learned class, and is yearly increasing its facilities and resources in that direction. This is true even in regard to branches of scholarship, such as the classical languages and philology, which might be thought less likely to awaken interest in a new and democratic community. Whatever advantage, therefore, can come to us from a liberal provision for the higher learning we may consider as already assured.

That culture and learning are delightful and profitable possessions no one, we think, but an extremely uncultivated and narrow-minded person would deny; but, taking what may be called a sociological view of the subject, we have sometimes been led to wonder whether the immense sums of money which have been appropriated of late to university purposes have really been bestowed in the manner most useful to the country at large. A day or two ago our eye fell upon the following observations in one of our most valued contemporaries: "In truth, one of the most startling things in connection with our collegiate education is its failure, as a rule, to prevent the graduate, when he enters politics, from sinking mentally to the existing political level. This has been the history of the larger number of what are called our 'gentlemen in politics.' They rarely spend a year with politicians without adopting their standards and their view of civilization." Most persons, we imagine, can confirm this from their own experience. But, if the scholar sinks through contact with the politician, how are we to explain the low level at which the latter lives? With whom is he in contact on the other side? There is only one answer: With "the people."

This makes us reflect. Millions are being given for the endowment of the higher learning—that is, for the creation of a learned class. What is that learned class going to do for the rest of the community? The members of it will make, no doubt,

delightful society for one another; but, from the wider sociological standpoint, what function are they going to fulfill? Will they in any powerful and effective manner help to sustain and strengthen the ideality of less favored classes; or will they live their lives apart, each in his own little "palace of art" constructed by the spirit of self-love and exclusiveness? If they can be counted on to do the former, then the millions are most wisely expended; but if the latter is to be the outcome, then, beyond all doubt, the millions might have been better applied. We believe in natural differentiations, but not in artificially created distinctions; and unless our highly educated class can accept and discharge some social ministry that will have the effect of communicating to others some share in what they have obtained themselves, it seems to us that this vast expenditure of money for higher education may lead to social results of a rather undesirable kind. The university graduate, as we have seen, is cutting a very poor figure in politics. The politicians by profession will not let him do otherwise; and he seems to have no power whatever of appealing to or influencing the people against the politicians. The reason why he is thus powerless —admitting, what perhaps there is no reason to admit in some cases, that he has any ideal of his own above the common—is that the life of the people is almost untouched by any kind of ideality, and that the popular habit of mind is opposed to the recognition of any leadership based upon superiority of mental or moral endowment. We are thus led to the unwelcome conclusion that there is but little diffusion of culture in any true sense among the people, and that it is the general lack of it, and the absence of any interest in larger questions, which give to our politics that character of dreariness and pettiness, not to mention a constant tendency to corruption, which all careful observers have noted.

One careful observer has lately consigned his observations to the pages of the Atlantic Monthly; we refer to the article contributed to the March number of that periodical by Mr. Francis C. Lowell, under the title of Legislative Shortcomings. It is of the Massachusetts Legislature, in which he had two years' experience, that Mr. Lowell speaks. "The first object," he says, of a member elected thereto, "is to secure the passage, or more rarely the defeat, of some legislative measure of only local importance. . . . Occasionally, but not often, this measure is an iniquitous job. Usually the member has no pecuniary interest in it, and often it is little more than a matter of legislative routine. Even when it is unwise, it is frequently nothing worse than a piece of legislative fussiness; or perhaps it was devised to meet some local demand, and is objectionable only on account of the bad precedent it establishes; such, for example, as acts to enable a particular town to subsidize a steamboat or a variety show for the convenience or amusement of its summer visitors. . . . If the member's pet measure is not a local matter, but an act of general importance, he runs the risk of being deemed a crank. If he should strenuously seek the passage of several measures, really important, he would be thought wholly devoid of common sense, and his influence would soon disappear." Then, in order to get his own little bill passed, the member, Mr. Lowell tells us, has to trade his vote—that is to say, he must vote for other men's bills, be they good or bad, if he wishes them to vote for his. If he should fail to do this, "his constituents, without

regard to party or condition, would probably deem him faithless to his principal duty."

If such things are done in the green tree of Massachusetts, what may we expect in the drier wood of less happily conditioned States? The Atlantic Monthly would render a great service if, taking this article of Mr. Lowell's as the first of a series, it would give us a dozen or so of similar studies of other State Legislatures. Nothing would more effectually hold up to us a mirror in which to see our true social and political status. Meantime let us first ask how such a condition of political intelligence as Mr. Lowell depicts tallies with the vast apparatus we already command, and the vaster we are daily acquiring, for the promotion of higher learning. When do our learned men propose to swoop down from their heights with culture in their wings for the help and inspiration of the masses of their countrymen? Or is this a matter which they think may safely be left to the common schools?

In this uncertainty as to what the learned classes are going to do for the commonwealth, we sometimes wonder whether it might not be possible to divert advantageously to purposes of popular culture some portion of the wealth which is now finding its way in lavish streams to already well-endowed seats of learning. How the money, if available, could best be applied is an interesting question as to which we should be glad to receive suggestions from our readers. We have more than once heard regret expressed—and we share the feeling ourselves—at the almost complete disappearance of the lecture system which was doing so much useful work a generation ago. The newspaper has superseded the platform; and yet the platform, we do not hesitate to say, was a more civilizing force in some respects than the newspaper. For one thing, it "uttered nothing base," which is more than can be said for the newspaper. It gave the people high thoughts, interesting ideas, pure sentiments, and useful knowledge. It was not occupied with idle gossip, or mean personalities, or the criminal side of life. It is not fully replaced even by *good* books and papers. As Prof. Corson says in his interesting little book on The Aims of Literary Study: "The intellectual coefficient can be apprehended through silent reading; the main object of vocalization is to exhibit the spiritual coefficient, which is indefinite to the intellect, and needs to be vocally rendered as much as a musical composition needs to be vocally or instrumentally rendered." There was, moreover, a certain social stimulus afforded by the lecture system which the private reading of even good literature does not supply.

We conceive, therefore, that a wealthy man, desiring to benefit the people at large, might with great advantage establish not lectureships but rather readerships. The literature of to-day and of past days contains ample material for the instruction and delight of popular audiences if read aloud by a properly trained elocutionist. Our idea would be to have such readings entirely free, except that local expenses in the way of hall hire, etc., might be met by the locality; and we should further propose that the reader should in each place that he visited give a course of lessons, also free, in correct reading. For the results which might be expected to accrue from such measures we would refer to the little work by Prof. Corson already mentioned, and to another by the same author entitled The Voice and Spiritual Education. If Prof. Corson is right, culture, no less than faith, comes mainly by *hearing;* and an

agency, therefore, by which the best literature of the day and of all days should be brought home to people's hearts through the tones of a sympathetic human voice could not fail, in course of time, to produce very beneficial effects both mental and moral. Within the household itself nothing is more humanizing than good reading (aloud); and this would be promoted by such public readings and such instruction as we have in view. We hear not infrequently of gifts of a million dollars or more to a single university; and we think it is time that something should be done for those who have no opportunity to become very learned, but whose minds might by proper effort be attuned to what is best in literature, and thus raised above the dreary level of commonplace ideas and petty personal concerns.

SPENCER AND DARWIN.

A COUPLE of years ago, as some of our readers will remember, a book was published under the title of From the Greeks to Darwin, in which the history of the doctrine of evolution was sketched, or at least purported to be sketched, from the earliest times down to our own day. The most remarkable thing about the book was that, of set purpose, it ignored the greatest thinker on evolutionary lines that the world had ever seen; we mean, of course, Herbert Spencer. This omission was duly noticed in our columns at the time, and there is no need to go over the ground again. What we wish to say to-day is that, if Mr. Spencer's position in relation to the doctrine of evolution needed any vindication, it has received it in ample measure in Mr. Edward Clodd's recently published book, Pioneers of Evolution, and in the article by Mr. Grant Allen contributed to the Fortnightly Review and republished in our last number. No one can read either the one or the other without feeling that to discuss evolution in its broader aspects without making due mention of Spencer is like narrating the discovery of America with but slight mention of Columbus. To Mr. Spencer we owe a rational and systematic statement of the doctrine of universal evolution; to Darwin we owe an original and lucid explanation of the natural process by which species are modified and new species formed. The latter was indeed a most solid and substantive piece of work, but it did not furnish the general formula of evolution, which but for the labors of Herbert Spencer would still be to seek. It was Darwin himself who said of Spencer: "I suspect that hereafter he will be looked upon as by far the greatest living philosopher in England; perhaps equal to any that have lived."

We feel how times have changed when to be recognized as a potent contributor to the establishment of the doctrine of evolution is one of the highest honors, if not the highest honor, which a philosophical thinker can enjoy. When Darwin published his Origin of Species, and for some years later, his name was cast out as evil; to-day it is difficult to keep an admiring public from claiming for him the authorship of that much wider scheme of evolution for which Mr. Spencer properly stands sponsor. The record, however, is very clear, and no one needs to be in error as to the respective achievements of the two men. Both have done great work for the intellectual emancipation of mankind, and the names of both will go down with glory to posterity.

Scientific Literature.

SPECIAL BOOKS.

THE first volume of the Story of the West Series dealt with a class that is becoming smaller and weaker, the second concerns one that is growing larger and stronger.* The miner, however, is changing his characteristics hardly less rapidly than the Indian, hence it is none too early to put his picturesque past on record. Mr. Shinn takes the development of the great Comstock Lode of Nevada as typical of all the various phases of mining, from the scratching of the prospector to the stupendous feats of the engineer—as typical also of the leap into bonanza and the sinking into borrasca. The Mormons made the first notable efforts to settle the region that is now Nevada, but the growth of the mineral interests soon took it out of their control. In describing the placer mining and the first quartz prospecting that preceded the discovery of the Comstock Lode, Mr. Shinn introduces some of the restless pioneers that gave the mining camps of the period their rough and picturesque character. After the great discovery was made in 1859, came the rush across the Sierras which brought other choice spirits who figure in the early times of Virginia City. There were the industrious and unfortunate Grosh brothers; the bombastic, scheming, and ineffective Comstock who gave his name to the great Lode; drunken "Old Virginia," who christened Virginia City with an accidentally broken bottle of whisky; the wily gamblers and their often hard-working but reckless victims; enterprising traders and energetic teamsters; while the nationalities represented included Irishmen, Frenchmen, Germans, Canadians, Mexicans, Indians, and Jews. Mr. Shinn shows us the trails almost impassable with snow or mud along which a constant stream of pilgrims was toiling, the crowded public houses, the conglomeration of huts, tents, and dug-outs that made up a mining camp, and the abandoned pits and shafts which often entrapped straying animals and men. Passing from these primitive scenes, he shows us the various phases of the great industry which mining has become in our western country. He tells us how the crude methods of treating ores used by the early prospectors were succeeded by the *arrastra*, and this by the stamp mill; how some great mechanical problems were solved, such as timbering the wide Comstock Lode and bringing the water supply of Virgina City through a fourteen-mile flume and seven-mile siphon from Hobart Creek, and how the freighters, stage-drivers, and lumberers made money by letting the mines alone and devoting themselves to dependent industries. Mining litigation and stock speculation each have a chapter. We have an account of the days of the great bonanza, in which the operations of Mackay, Fair, Flood, O'Brien, and others are described. Perhaps the greatest engineering feat that figures in the story is the Sutro Tunnel—the "coyote hole," as contemptuous opposition termed it. In conclusion we are told what a present-day mine is like, both above and under ground, and what sort of men now make up its community. The volume is illustrated with many fittingly picturesque views.

* The Story of the Mine. By Charles Howard Shinn. Illustrated. New York: D. Appleton & Co. Pp. 272, 12mo. Price, $1.50.

Judging from the account of Mr. *Loomis*, there is much enjoyment to be had incidentally from a scientific expedition to a strange land.* Merely passing over unfamiliar ground and observing its natural features, its inhabitants in their everyday aspect, and its ordinary sequence of events has its interest. But when the traveler is engaged in operations that are enough out of the common to appear somewhat weird to the non-scientific native and arouse his active curiosity, traits are brought out that do not appear to the ordinary visitor. A more realizing sense of the physical, political, and industrial condition of a strange land, too, is obtained when one has to accomplish a definite piece of work with the means that it affords than when one is concerned merely with passing through it. Personal equation is quite as much a factor in books of travel as in scientific observations. How much we prefer the writer who jots down the points that we take an interest in and answers the queries that arise in our minds as we follow his narrative! The reader with scientific tastes especially will enjoy Mr. Loomis's book. It describes the journey of the United States Scientific Expedition to West Africa in 1889–'90, the preparations for viewing the eclipse of the sun, and the return. After crossing the Atlantic, stops were made at the Azores, Cape Verd Islands, Sierra Leone, and on the Gold Coast before the destination of the expedition—Saint Paul de Loanda—was reached. On the return, Cape Town, the diamond mines of Kimberley, Saint Helena, Ascension, and Barbados were visited. The book gives abundant evidence that our author, in addition to his ability to record matters of exact observation, is not without a realizing sense of the beautiful and inspiring in Nature. The volume is handsomely printed, and is copiously illustrated with reproductions of photographs taken by members of the expedition.

Another careful study of a special field has been added to the Criminology Series.† The habitual criminal presents a much more serious problem than the occasional offender. Criminal habits, like most others, are formed in youth; hence any diminution that can be secured in the amount of juvenile crime will tend to reduce the most troublesome class of criminals. At present the author's study of statistics and other pertinent facts indicates that juvenile crime is increasing in both Europe and America. Its distribution agrees substantially with that of adult crime. While the bulk of juvenile criminals are boys, Mr. *Morrison* finds that "female offenders are rather more likely to descend into the ranks of habitual criminals than male offenders." He accounts for this largely from the fact that "females are, as a rule, later in being subjected to reformative discipline than males, with the ultimate result that this discipline is less effective when at last it has to be resorted to. It is therefore," he continues, "no real kindness to female children, when they exhibit symptoms of habitual delinquency, to allow these symptoms to develop unheeded." As to the kinds of crime committed by children, our author finds that petty theft and vagabondage are by far the most prevalent, mental and physical immaturity making it impossible for the young to be serious offenders against either person or

* An Eclipse Party in Africa. By Eben J. Loomis. Illustrated. Boston: Roberts Bros. Pp. 218, 8vo. Price, $4.50.

† Juvenile Offenders. By W. Douglas Morrison. New York: D. Appleton & Co. Pp. 317, 12mo Price, $1.50.

property. It appears that most juvenile criminals are undersized and sickly, and many have a feeble intellect, bluntness of feeling, or unstable will. The operation of heredity has fastened these defects upon them, as a rule, so that they must be regarded as belonging to a decadent class. Besides the production of such disabilities the influence of parents often operates to rear young criminals through the conditions and associations of the home. From this examination of the production of juvenile crime our author turns to consider measures of repression. He finds that the plan of suspended sentence is very promising, especially with first offenders. A fine which may be paid in installments, or, in other words, a sentence to compulsory labor without imprisonment, also commends itself to him, but he has little faith in the efficacy of corporal punishment, in spite of the recent advocacy of it. Ordinary imprisonment, which he discusses in considerable detail, he also finds unsuitable for the young. The corrective institutions that have become numerous of late years seem to him to go to the root of the difficulty, as they aim to correct the defective physical and moral condition of the juvenile delinquent, and thus aid him to keep from future lapses. Mr. Morrison urges more intelligent supervision of inmates after their discharge from such institutions, which could be combined with conditional release before the expiration of the term of commitment. The book can not fail to be of service to all who have to deal with vicious tendencies in the young.

It is a long step from the time when prehistoric man fashioned his rude weapons and battled with the rhinoceros and cave bear to the era of such a civilization as that of the Akkads, depicted for us by Mr. Anderson.* To these early Chaldeans Babylon and Assyria were indebted for their cuneiform characters and much of their culture. At Lippur, 3800 B. C., they possessed an extensive library. Some of their works on astronomy, being unearthed three thousand years later, proved sufficiently new to be studied by the Assyrians. In art they showed more skill than succeeding nations, and also made considerable progress in science, being acquainted with the sidereal year and reckoning the latitude of stars. They used the clepsydra, lever and pulley, lenses, and possibly telescopes, since tablets have been found apparently referring to the four moons of Jupiter.

It is almost incredible that the name and memory of a nation so extensive as to include all of Asia Minor and northern Syria, and powerful enough to be courted by Egypt in the time of the great Sesostris, could be blotted out of history for two thousand years. Yet this is the case in regard to the empire of Khita, and the story of her greatness has to be interpreted anew for us from the walls of Thebes and Egyptian temples. The Hittite inscriptions which are found in Asia Minor are as yet a riddle to scholars.

Other of the ancient civilizations happily did not fall into such oblivion, and concerning the distinctive features of each of these—Babylonia, Egypt, Phœnicia, the Hebrews, the Arabs, and ancient Persia—the author discourses ably and graphically.

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* The Story of Extinct Civilizations of the East. By Robert E. Anderson. New York: D. Appleton & Co. Pp. 213. Price, 40 cents.

GENERAL NOTICES.

THE strong efforts now being made to develop a vehicle that shall propel itself, and the measure of success already achieved, promise the early attainment of an advance in locomotion as great as that afforded by the introduction of the safety type of bicycle. A good idea of the mechanical principles that are being employed in the solution of the problem may be gained from a translation of a recent book by a French engineer.* Of the four kinds of motor that have been applied to self-propelling vehicles—steam, electric, compressed air, and naphtha—the author has by far the most hopes of the last, and gives most space to this type in his book. His early chapters are devoted to a statement of the mechanics of steam and other gases, and he gives here also the theory of the electric motor. In describing the various systems of steam traction he gives first place to the Serpollet generator—the only generator of steam allowed for traffic in the large cities of France. Other steam motors that find place here are the Le Blant, De Dion & Bouton, Bollée, Filtz, Rowan, and Francq. Compressed-air autocars are represented by the Popp-Conti tramway and the Mékarski system. M. Farman is naturally most familiar with motor wagons of European origin, but he has inserted such accounts as were accessible to him of the American types. Among petroleum motors he ranks as king the one invented by the German Daimler, which is employed in the carriages of Panhard & Levassor, Peugeot, Gautier, and other builders. He gives a full description of this, and describes also the Roger car with the Benz motor, the Gladiator auto-cycles, the Duryea, Kane-Pennington, Tenting, and Delahaye cars, and several machines so far used only for agricultural or other industrial purposes. Electric carriages are represented by the Jeantaud, Morris & Salom, and Bogard. His concluding chapter deals with lubrication, tires, bearings, and other details. Over a hundred carefully drawn figures and diagrams illustrate the volume.

The notes which the reader will find in Miss *Merriam's* attractive volume were taken at Twin Oaks in southern California.* The author is a bird enthusiast who, before going to the Pacific coast, had known only the birds of New York and Massachusetts. "Every morning right after breakfast" she has her horse brought round, and together in silent sympathy she and Canello, the faithful patient little broncho, go the rounds of the valley, getting acquainted with the birds as they come from the south. Canello liked well to "watch birds in the high alfalfa under the sycamores, but when it came to standing still where the hot sun beat down through the brush and there was nothing to eat, his interest in ornithology flagged perceptibly." Then after dinner the author strolls through the trees to get a nearer view of the nests. The white egret, the green heron, the spotted sandpiper, the valley quail, are as fascinating to Miss Merriam as are the ants to Sir John Lubbock. Her description of all the birds is marked by a charming simplicity and by a beautiful use of English. She is in touch with Nature, with an eye for color, an ear atune to melody, and intellect clear and clean. It is a pity that we have not more such books as this and more such women as the authoress. We can imagine no better mental tonic than a ride on horseback in the early morning while the dew is on the grass, with the authoress as a chaperon and teacher of bird lore, for the weary city woman who needs to be lulled back to rest and get mental and physical health on the bosom of Mother Nature.

Prof. *Ramsay*, who was associated with Lord Rayleigh in the remarkable discovery of argon, has written a popular historical sketch of the several investigations that have given us our present knowledge as to what air is composed of.† He begins with the work of Robert Boyle, who published about 1650 his Memoirs for a General History of the Air, and proceeds with the less known labors of John Mayow and Stephen Hales.

* Autocars. By D. Farman. New York: The Macmillan Co. Pp. 249, 12mo. Price, $1.50.

* A-Birding on a Bronco. By Florence A. Merriam. Boston: Houghton, Mifflin & Co. Price, $1.25.

† The Gases of the Atmosphere. By William Ramsay, F. R. S. London and New York: The Macmillan Co. Pp. 240, 12mo. Price, $2.

From some passages in their writings it would seem that each of these worthies came within a step or two of discovering all the main facts relating to the composition of the air, but each failed to look quite far enough in the right direction. Boyle, it appears, reasoned shrewdly from imperfect observations; Mayow died young; while Hales accumulated many and definite experimental facts, but lacked the ability to make use of them. All were hampered by the current errors of their time, among which the chief were the inability to distinguish one gas from another, lack of attention to gain or loss of weight, and above all erroneous ideas regarding combustion. Prof. Ramsay shows how the phlogistic theory, which came up about the end of Boyle's life, interfered with the researches of his successors—Black, Rutherford, Priestley, and Cavendish—until it was overthrown by Lavoisier. We are told something about the achievements of each of these men, and the account is made more interesting by including descriptions and portraits of the men themselves. After Cavendish little apparently remained to be done but to make more exact determinations of the constituents that had been found in the air. But in the course of some investigations in 1892 Lord Rayleigh noticed that nitrogen prepared from ammonia is somewhat lighter than atmospheric nitrogen. A research undertaken to find the reason for this difference brought out the existence of the inert argon. The circumstances of the discovery and the reasoning which led to it are set forth by Prof. Ramsay, who adds chapters giving the properties of argon and its position among the elements. The author has succeeded well in keeping his book within the comprehension of the persons without special scientific training for whom it was written.

Prof. Crockett's *Elements of Plane and Spherical Trigonometry*,* by a mathematician of note who is Professor of Mathematics and Astronomy in the Rensselaer Polytechnic Institute, has been prepared for the use of beginners in the study. Assuming that a high degree of proficiency can not be expected from such students, the author, not striving after original demonstrations, has limited himself to the selection of simple proofs of the formulas, to which geometrical proofs have in many cases been added. The definitions and explanations are admirably clear and concise. The numerical examples have been computed by the author, with special attention to correctness in the last decimal place. The tables are a special feature, are printed from differentiated type, and on paper of a different tint from the text, so as to make them easier to turn to. They give five places, while the angles in the examples are given to the nearest tenth of a minute. We find the book lucid and convenient.

The recent book of Prof. Keasbey * on the Nicaragua Canal urges frankly and emphatically the choice of the Nicaragua route for a canal across Central America, and the assumption by the United States of a dominant position in the political control of this water way. The author opens his discussion with a brief description and comparison of the ten or twelve more or less distinct routes that have been proposed, expressing the decided conviction that the Nicaragua and Panama routes are the only two worth considering, with the advantage on the side of the former. The greater part of the volume is devoted to a history of the attempts that have been made to construct canals in this region and to obtain political control of the territory through which they would pass. The record begins with the first Spanish explorations, and mentions canal projects of Spanish engineers formed before 1550. A chapter on the English freebooters opens an account of the struggle between England and Spain, lasting into the early part of the present century. The term from 1815 to 1865 Prof. Keasbey characterizes as a period of private initiative in canal projects. Two events in this division of his record which have an important bearing on the idea of cutting the American isthmus are the enunciation of the Monroe doctrine and the execution of the Clayton-Bulwer treaty. The time since 1865 he describes as a period of governmental activity in this matter, and he closes his chronicle of recent events by giving his view of the po-

* Elements of Plane and Spherical Trigonometry, with Tables. By C. W. Crockett. American Book Company. Pp. 311. Price, $1.25.

* The Nicaragua Canal and the Monroe Doctrine. By Lindley Miller Keasbey. New York: G. P. Putnam's Sons. Pp. 622, 8vo. Price, $3.50.

litical, the technical, and the diplomatic situations of to-day with regard to the two chief routes. In his concluding chapters he argues for the construction of a canal as of transcendent importance to the economic development of America, and gives his reasons why the United States should control the passage. The volume is carefully indexed and contains four maps.

Among the papers accompanying the *Report of the United States Commissioner of Education for 1894–'95* are two dealing with important subjects connected with the educational system of Great Britain. One of these is the question of religious instruction in the free schools, and the other is the organization of secondary education as shown by the report of a royal commission. The legal aspects of the Manitoba school case are given in another contribution. Foreign matters of interest treated in other papers are the university education of women in England, the educational status of women in various countries, and English teaching on the history of the American Revolution. Of domestic interest are the chapters on teachers' pensions, Chautauqua education, and early educational history in the United States.

The book on *Alternating Currents and Alternating Current Machinery*, by *Profs. Dugald C* and *John P. Jackson*, forms Volume II of their text-book on Electromagnetism and the Construction of Dynamos (Macmillan, $3.50). The authors have followed in it methods that have been found advantageous in teaching other branches of engineering. The volume is designed to present the fundamental phenomena of alternating currents as met with in engineering practice, and to point out their controlling principles and applications. Descriptions and illustrations of commercial machinery are not included *per se*, though where practical data may be useful in illustrating deductions in the text they are copiously used. For the fuller information of the reader, a large number of references are given in footnotes. In the chapters on polyphase currents the authors could not hope to supply a list of references that would remain long adequate, as material of overshadowing importance is being constantly published. Descriptions of experiments having only historical interest have been carefully excluded. In the use of mathematics the authors have sought to avoid presenting unnecessary formulas on the one hand, or giving results without reasons on the other. Numerous original demonstrations of the standard formulas have been introduced and a few additions have been made to the nomenclature. The volume contains over three hundred diagrams and other figures, and is adequately indexed.

In a neatly printed little pamphlet *H. Edwin Lewis* has discussed *The Philosophy of Sex* scientifically, delicately, and impressively. His chapter on Reproduction and the Origin of Sex and that on the Nature and Relation of Sex lead up to an earnest appeal for sexual purity, which can not fail to help well-intentioned persons who are weak or thoughtless or who do not know where to turn for guidance. (Vermont Medical Publishing Co., Burlington, 35 cents.)

Much out of the common run of text-books is *Number and its Algebra*, by *Arthur Lefevre* (Heath, $1.25). It deals with the theory of numerical operations, and is designed to be introductory to a collegiate course in algebra. It thus bears a similar relation to algebra that the chapters on chemical philosophy in books on chemistry bear to their main subject. The mathematical operations whose natures are explained range from counting up to work with radical surds, undetermined coefficients, roots of integral and quadratic equations, radix fractions, and functions. The several chapters are based on lectures which the author has given for a number of years to his university students with the especial design of aiding the large part of them who were preparing to teach, hence pedagogical applications will be found throughout the book. "Plainly the first step," says the author, "to the understanding of the algebra of number is to understand the nature and laws of number. It is hoped that these lectures have been a fairly adequate guide and stimulus to th' step. After mastering what may be called the vocabulary of the language (proficiency in this matter has been assumed), the next step is to grasp the idea of algebraic *form*. In the study of algebra this should be the main standpoint. It is only by following out the problems which arise in a systematic

study of algebraic form that the modern developments of pure algebra, or its applications to geometry, can be rightly comprehended."

From the Department of Agriculture we have received *Insects affecting Domestic Animals*, an account of the species of importance in North America, by *Herbert Osborne*, Professor of Zoölogy and Entomology, Iowa Agricultural College. This report gives, in about three hundred pages, a description of all the parasites the stock raiser has to contend with. After an introductory chapter on parasites in general, the following six chapters deal with the various pests in detail. The seventh chapter tells of remedies and preventive treatment. Classified lists and a bibliography complete the pamphlet. The report represents the result of investigations carried on at intervals since 1885. In the words of L. O. Howard, entomologist to the department, it "will form an excellent textbook of the subject, and is a work which should be in the hands of all stock raisers." It is fully illustrated by plates and cuts.

Observations on the Fur Seals of the Pribiloff Islands—Preliminary Report by *David Starr Jordan*, Commissioner in charge of Fur-seal Investigations for 1896—brings some interresting data as to the condition and the fishery of seals on a little cluster of islands in the Bering Sea. Under different headings it describes the islands, the rookeries, habits and breeding of the seal, and the different modes of killing, and their effects. A number of statistical tables put these difficult investigations on a scientifically accurate basis; and a map appended to the pamphlet locates the routes of the seal under way.

The February number of the *Expositor*, a theological magazine, opens with a rather searching criticism of Ian Maclaren's The Mind of the Master, by the Lord Bishop of Derry and Raphoe. He points out what to him seem numerous errors of interpretation of the Gospels; and from his Anglican point of view the Rev. John Watson's broad if not exactly new proposition—that of substituting the Sermon on the Mount for the creeds of Christendom—would mean a giving over of Christianity altogether. Among the other papers of interest to lay readers may be mentioned Christian Perfection, by the Rev. Joseph Agar Beet; John's View of the Sabbath Rest, by the Rev. George Matheson; and The Priest of Penitence, by the Rev. E. N. Bennett. Among the reviews a large space is given to books on social topics. Two of these reviews are by Prof. Richard T. Ely, and one by Prof. William Adams Brown.

The *Analytic Keys to the Genera and Species of North American Mosses*, prepared by *Charles R. Barnes*, and published by the University of Wisconsin, is a new edition and enlargement of a Key to Genera published for free distribution in 1886, and Keys to Species published in 1890, and is intended to serve the same purpose as they—of furnishing a convenience to students rather than to present a critical study of North American mosses. It includes, therefore, a very large number of new species that have been described since 1890. For the benefit of amateurs, though specialists may not need them, collected descriptions are appended of all species not found in Lesquereux and James's Manual. The attempt is made to include all the species reported or described as belonging to our flora, unless later study of the genus has shown the addition to be untenable; and such special studies are cited in the Keys. Pains have been taken to include as many of the barren and insufficiently described species as possible, in order that they may be recognized, if they exist, or may be referred to their proper place. Varieties are not discriminated, but inquiry into the subject is suggested. The work of preparing this edition has been largely done by Mr. de F. Heald, with the co-operation of the author.

Prof. *G. Frederick Wright's* comprehensive and fully illustrated account of *The Ice Age in North America*, which first appeared in 1889, reached its fourth edition in 1896 (Appletons, $5). Detailed work upon the glaciated areas has been going on actively since the third edition came out, but Dr. Wright finds no occasion to modify materially his original statements, either of fact or of theory. In his preface to the new issue he gives a list of papers in which the results of this recent work have been em bodied, accompanying it with notes on the

contents of many of the papers. He inserts also a map prepared by Mr. Warren Upham showing the three stages in which Prof. T. C. Chamberlin has classified the glacial formations of North America and the later lines of recession toward the northeast. Prof. Wright sees many open questions in glacial geology "inviting the continued attention of local observers and promising to all interesting and important discoveries."

The *Report of the New York State Board of Charities for 1895* gives evidence of a year of active work. The report proper is accompanied by a large number of special reports of inspections by one or more members of the board, made to ascertain the general condition of the several hospitals, almshouses, children's homes, and other charitable institutions in the State or to investigate alleged abuses. Institutions found to be in good condition are cordially praised, and defects are unhesitatingly condemned. The ordinary operations of the institutions under the supervision of the board are fully shown in tables.

PUBLICATIONS RECEIVED.

Agricultural Experiment Stations. Bulletins and Reports. Cornell University: The Pistol-case-Bearer in Western New York. By M. V. Slingerland. Pp. 17; A Disease of Currant Canes. By E. J. Durand. Pp. 16.—Michigan: Bacteria: What they Are and what they Do; and Ropiness in Milk. By C. E. Marshall. Pp. 44.—New Jersey: Report of the Botanical Department for 1896. By Byron D. Halsted. Pp. 136.—New York: Director's Report for 1896. Pp. 30; The Cucumber Flea-beetle as the Cause of "Pimply" Potatoes. By F. C. Stewart. Pp. 10; Economy in using Fertilizers for raising Potatoes. By L. L. Van Slyke. Pp. 14.—Ohio: Potatoes (Cultural Notes, etc.). Pp. 16; Beet-sugar Production. Pp. 32; Investigations of Plant Diseases in Forcing-house and Garden. Pp. 26; Newspaper Bulletin on Black Knot, etc. Pp. 2.—Purdue University: Ninth Annual Report. Pp. 61.—United States Department of Agriculture: The Carbohydrates of Wheat, Maize, Flour, and Bread; and the Action of Enzymic Ferments. By W. E. Stone. Pp. 44; Grasses and Forage Plants of the Rocky Mountain Region. By P. A. Rydberg and C. A. Shear. Pp. 48.

America and the Americans from a French Point of View. New York: Charles Scribner's Sons. Pp. 273. $1.25.

Angot, Alfred. The Aurora Borealis. New York: D. Appleton & Co. (International Scientific Series.) Pp. 264. $1.75.

Balch, E. S. Ice Caves and the Causes of Subterranean Ice. Philadelphia. Pp. 18.

Baldwin, Joseph. School Management and School Methods. New York: D. Appleton & Co. (International Education Series.) Pp. 395. $1.50.

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Fragments of Science.

Horticultural Extension Schools.—Experiments in methods of extension teaching as applied to horticulture have been made by Prof. L. H. Bailey in connection with the Cornell University Experiment Station, through itinerant or local experiment, readable expository bulletins, the itinerant horticultural school, elementary instruction in rural schools, and correspondence and reading courses. The greatest good as yet accomplished seems to have come through the bulletins. These have taken the form of surveys of the status of certain industries, with especial attention given to floriculture and ornamental gardening. Besides the consecutive teaching of horticultural schools, Nature study and object lessons were taught in a series of schools, with the object, besides imparting specific horticultural information, of awakening closeness of observation and careful reasoning from it on the part of the attendants. Observation lessons constituted one of the most useful exercises in connection with these schools. Small objects, like leaves or roots or flowers or seeds, were put in the hands of all the attendants, and after they had examined them for a few minutes the instructor began to ask questions concerning them. This exercise drilled every participant in observation and in drawing proper inferences from what he saw, and was productive of the greatest interest and good. Such schools serve better as the culmination of a series of extension efforts than as a primary or preliminary means of awakening the rural communities. Another series of lessons had the determination of the manner in which pupils could be reached by means of object-lesson teaching, and the amount of interest they would be likely to manifest in agricultural matters in case it should ever be found desirable to introduce such teaching as a part of the distinct school work. The conclusion is drawn by Prof. Bailey, from this experimental work, that the farmers, as a whole, are willing and anxious for education. They are difficult to reach, because they have not been well taught, not because they are unwilling to learn.

Effect of Veils on Eyesight.—In experimenting upon the effect of the wearing of veils upon the eyesight, Dr. Casey A. Wood, of Chicago, selected a dozen typical specimens of veils and applied the ordinary tests of ability to read while wearing them. These tests showed that every description of veil affects more or less the ability to see distinctly, both in the distance and near at hand. The most objectionable kind is the dotted veil. Other things being equal, vision is interfered with in direct proportion to the number of meshes per square inch. The texture of the veil plays an important part in the matter. When the sides of the mesh are single, compact threads, the eye is much less embarrassed than when double threads are employed. The least objectionable veil

is without dots, sprays, or other figures, but with large, regular meshes made with single, compact threads. Eye troubles do not necessarily result from wearing veils, for the healthy eye is as able as any other part of the body to resist the strain they impose upon it. But weak eyes are hurt by them, and prudence should teach not to strain healthy eyes too much.

Domestication of the Egret.—A resolution was adopted at the International Zoölogical Congress held in Leyden in 1895, favoring measures for the preservation and domestication of the egret. Under present conditions the bird, so highly prized for its plumes, is undergoing rapid extermination. M. J. Forest, the author of the Leyden resolution, is confident that the domestication of the egret herons will be found as practicable as that of the ostrich has proved to be. The little egret, or garzette, in particular, has already shown itself quite susceptible to the taming process. In a heronry established at Tunis in 1873, a flock of thirty young birds has increased to about four hundred. The establishment contains a pool and trees, and cost less than twenty-eight hundred dollars. It was stocked in the beginning with captured wild birds, whose disposition and capacity to breed did not seem to be affected by their captivity. The proprietor represents that he gets six or seven dollars a year from each bird, plucking the plumes twice a year, in June and October, besides the increase of the flock. The capacity of the large egret for domestication is not so well established; but a specimen of this bird, which had been captured wild and then tamed, was sent to the *Jardin d'Acclimatation* in Paris from Guiana in 1853; and several travelers—Paul Marcoy, Thouar, the lamented Crévaux, and Ehrenreich—mention having seen in Paraguay and along the Amazon numerous domesticated birds, herons and grebes among them, living in the Indian villages on whatever they could find to eat there. Herons bearing ash-gray plumes are kept in some of the larger houses of Bagdad.

Inventing a Match.—The credit of the invention of chemical matches is claimed for various persons in different countries—for Friedrich Kamrer in Germany, Roemer and Preschel in Austria, Ironvi and Moldenhauer in Hungary, Ivan Worstakoff in Russia, Watt and Isaac Holden in England, and Charles Lauria in France. The one thing agreed upon is the date—1833. For Lauria the claim is made by M. Jacques Boyer that he thought about the matter in 1827, when he saw Gay-Lussac's hydrogen tinder box at Lyons in 1827, and had made a practical match before 1833. Immediately after witnessing Gay-Lussac's experiment he began to look for a fulminating powder which would enable him to realize the dream he had conceived, and while still in this search saw his professor of chemistry, Nicollet, produce the detonation of powdered sulphur and chlorate of potash. Then he thought that if he could incorporate phosphorus with this mixture he might produce the blaze he wanted. He had no apparatus but a few sticks of sulphur-tipped pine and some glass tubes. He had got some parcels of sulphur and chlorate from the college laboratory at Dôle, and having obtained a little phosphorus from a pharmacy, he proceeded to melt his mixture. As he was inexperienced and awkward at the work, he suffered a number of accidents, in which his bed curtains proved readier to take fire than his matches. At last he dipped the end of one of his sulphured sticks into the chlorate slightly warmed. Some of the chlorate adhered, and, rubbing his half-finished match on the wall where a trace of phosphorus had found its way, the stick blazed up at once. Lauria called his comrades and the principal of the college to witness his achievement, and enjoyed a kind of triumph. He made a few improvements in his invention, added a little gum arabic to his mixture to make it more adhesive, and had what is in principle the match of to-day. His fellow-students amused themselves with the matches, Prof. Puttenay made some for his own use, and they found their way into a *café* at Dôle, but the effort to find a more general market for them did not succeed.

Young Animals at School.—A new theory of the sports of young animals put forth by Prof. Groos, of the University of Giessen, holds that they are a preparation for after-life, for the adaptation of the faculties for the sterner purposes of maturity, and are in

effect dependent upon the necessity of modifying instincts. The higher an animal may be in the scale of life, the author assumes, the more varied become its relations to surrounding things and the less suited to varying circumstances becomes a mechanical and rigid instinct. If, however, there is a period of youth during which inherited instincts may be used merely as a vehicle for redundant energy, an opportunity is afforded for modification and alteration of the rigid system. The instinct of a creature with practically no period of youth, as with insects, must be complete and ready for use. The mammal or bird, however, passes through a period of youth "during which it has no immediate duties to perform and is cared for by its parents. In this time it plays with its instincts, learns to fly or to run and jump, to recognize its kind, to distinguish between the palatable and unpalatable, to make and understand call notes or cries of alarm; in a thousand ways to suit each occasion with its action and deserve a place in the hierarchy of intelligent beings." The games and sports earliest to appear in animals and most universal are classed by Prof. Groos as those of experiment and curiosity. "Young creatures play with everything that attracts their attention. They try their teeth or their claws on every available object. They taste and smell, rush and tumble about, collect in heaps or scatter everything they are able to reach, and, indeed, make attempts on the unattainable. The greater the intelligence of the adult animal the more surprisingly the young animal treats its surroundings in the spirit of an empirical philosopher. A young monkey observed by a sister of the late Prof. Romanes discovered for itself that the handle of a hearth brush was screwed into a socket. It succeeded in unscrewing the handle with ease, and after long experiments discovered that only one end twisted in a particular direction would fit into the socket. Another young monkey, chained just beyond the reach of a fire, found out how to tear strips from a newspaper and roll them up into tapers sufficiently long to reach the flames. By some such fertile employment of curiosity the professor thinks that the ancestors of man may have gained their mastery over fire." Skill in flying is attained by considerable practice, and "in mammals the exercises of the young bear a definite relation to adult habit. Mountain-living creatures, like kids and chamois, continually practice standing jumps, springing vertically into the air. . . . Gazelles, on the other hand, which have to jump watercourses and gullies on the Veldt, confine their youthful enthusiasm to practice of the running jump. Similarly the play of tiger cubs with balls or with the tail of their mother, and the wrestling and mimic combats of other carnivorous young, all exhibit an instinctive bias by which the restless zeal of youth is disciplined for the real purposes of maturity."

Seals and their Pups.—A fur seal has none of the altruistic instincts of some other animals, for it will never feed any pup but her own. Not a very affectionate mother at best, she yet unerringly knows her nursling's voice, and he in turn learns to find her. When they meet and recognize each other at meal time, it is easy to see that they belong together. Her duty done, however, she lets it shift for itself till the next feeding time. She instantly knows any little hungry intruder that is stealing up to her to get a meal on the sly. She cuffs and bites, until the starveling, intimidated, slinks away to die. These orphaned younglings are the fruit of the indiscriminate "pelagic" sealing. Their mother being killed, and they unable to obtain another nurse, they perish by the thousands. A United States report estimates the number for 1896 at 20,331.

The Last Resting Place of Pasteur.—On December 26, 1896, the remains of Pasteur were borne to their final resting place, a crypt at the Pasteur Institute. On the stone is inscribed a sentence from his reception speech at the Academy: "Heureux celui qui porte en soi un dieu, un idéal de beauté, et qui lui obéit—idéal de l'art, idéal de la science, idéal de la patrie, idéal des vertus de l'évangile" ("Happy he who bears within him a god, an ideal of beauty, and follows it—an ideal of art, an ideal of science, an ideal of patriotism, an ideal of the Christian virtues"). Many men of science and thinkers of note, both French and foreign, were present, and deputations and wreaths were sent by scientific societies. A service at Notre Dame, where the remains had been

reposing for the last fifteen months, was followed by the ceremonies at the crypt. M. J. B. Pasteur said to the council of the institute, in behalf of the family, "I intrust to you this tomb which we have raised to our father in this institute which he loved so dearly." Addresses were delivered by M. Rambaud, Minister of Education, and M. Baudin, President of the Municipality, and an address by M. Legouvé was read by M. Gaston Boissier.

Bachelor Seals.—The young male seals, commonly called "bachelors," are very much like the females in size and color. During the breeding season they are not permitted by the bulls to enter the rookeries, hence they herd together separately on the so-called "hauling grounds." Unlike their seniors, who in the "harems" are busy founding families, these young bachelors have no fixed place of abode, but range at will over a large area of ground, usually sand beaches near the rookeries. Known also as "killable" seals, they are driven from their haunts and killed with clubs at about three years of age, the time when their fur is at its best. Small four-year-olds and large two-year-olds, being about the same size as the bachelors, are also hunted. Among these herds may sometimes be found bulls from four to six years old, who, being too cowardly to assert themselves in the harems, are forced to keep company with these youngsters. Another mode of hunting them is called "pelagic sealing," which means killing them in the open sea with firearms, or with the spear and club. In order to digest their food, they lie sleeping on the surface of the water, and the hunter finds it easy enough to steal up in his boat and spear the defenseless animal. This is really wholesale slaughter, for the hunter indiscriminately kills whatever lies in his way, even the nursing mothers, thus leaving the pups to die of starvation.

Nationality and Scenery.—In the introduction to an article in the *Deutsche Rundschau* descriptive of the German landscape, Herr Friedrich Ratzel shows by a few well-directed allusions how the intrinsic character of the scenery of a region, even in its apparently most natural features, is affected by the nationality that occupies it, and reflects the character of that nationality. The allusions are local, but the principle they illustrate is general. A country with such a history as Germany's can have no purely natural landscape. The people and their land are the resultant of a long material development. When the Romans knew Germany—a barbarian region with few inhabitants—the works of man were less in evidence, and Nature prevailed. The effects of cultivation have worked in two principal directions: First, the woods are cleared up, the water is confined within limits, the habitations of men are multiplied and enlarged and made more durable, and new plants and animals are brought in. Then uncontemplated changes step in, which proceed of themselves from the works of cultivation. With the drying of the soil the climate is modified. The introduction of new plants and animals imposes new features upon the conditions of life. Where before only stretches of heath, moor, and swamp formed natural openings in the predominant forest, extensive woodless regions arise through the labors of man, from which the shade-loving plants and animals that were protected by the forest gloom disappear, and other inhabitants are at home in the cultivated fields. The variations in the particular shaping of these changes are more especially marked where the boundaries run through mountain regions. In the Saxon Erzgebirge the forests have lost all their wildness, and plantations of firs and oaks grow in regular order, all nearly of a height, with no trees towering into prominence, and the mountain has the trimmed and symmetrical appearance of a nursery. The brooks are tamed, dammed, and made to earn their right to be as the servants of the mills. Passing over the mountains and going down the Bohemian side, we are in the woods again, with the valleys free and irregular, and the brooks running according to their own will. The contrast is seen again, but less marked, in going up from Bohemia and down into Bavaria. Within Germany itself the garden-tilled plots near the industrial centers and the little rectangular holdings of the southwestern and middle districts, each distinctly marked off from its neighbor, and making the whole look like a party-colored checker-

board, impress one very differently from the immense fields devoted to single crops and the commodious barns of the north. Other differences may be seen on the upper Rhine, where the inhabitants of both sides were originally the same people, but have been subjected to different influences in the course of their history. The French have made their marks all over the Alsatian territory and in the towns of quite another character from the native German aspects of the Baden side.

A Survival of Torture.—Although the practice of torture to extract evidence was formally abolished in 1789, the spirit of the Inquisition has not yet died out in the continental countries of Europe. This is shown now and again in criminal cases. But not the convicts only are treated with the utmost severity. The mere suspicion of crime is enough to make a man's life miserable. He practically loses all civil rights, and finds himself at the mercy of an interrogating magistrate with full power to extract a confession, by moral suasion if possible, by more forcible means if need be. Subjected to a prolonged and tortuous system of cross-questioning, the accused often completely break down mentally and confess at random whatever has been suggested to them, much in the manner of the trials for witchcraft in our own Puritan New England. A case creating quite a sensation in Paris some thirty years ago was that of a woman who under this fire of interrogation admitted having killed her newborn infant, two months even before the birth of the child. If the culprits are suspected of obstinacy in answering, all sorts of expedients are used to make them more compliant, such as making their diet unpalatable, or altogether withholding food and water, and penning up in close, dark quarters.

Prof. Cannizzaro's Jubilee.—The seventieth birthday of Prof. Stanislas Cannizzaro was celebrated on November 21, 1896, amid a concourse of the most distinguished scientists and other men of note of Rome. He was presented with a gold medal and a bust of himself in bronze, and received innumerable letters, telegrams, addresses, and *pergamenas* from the leading scientific societies of the world. Prof. Semeraro, Rector Magnificus of the Roman University, said in his address: "His greatest glory lies in the fact that most of the professors now teaching in Italian universities have been his pupils. The pressure of business as vice-president of the Senate and member of the Superior Council of Public Instruction, and many others, never were pretexts to him for overlooking the modest duty of a teacher." Hon. Galimberti, presenting him with the Grand Cordon of the Crown of Italy, said: "Your name is worthy of being joined with those of Galileo, Torricelli, Volta, and Galvani. To Emanuel Kant, who, in his absolute sentence, considered chemistry as a union of empirical knowledge, you replied half a century ago, pronouncing among the confusion of doctrines immovable ideas and true laws that render chemistry an exact science, for it lies now on mathematical truth." Cannizzaro replied in an interesting speech. Referring to the combination of the functions of teacher and investigator, he said: "Had I not been a teacher, my publications would not have appeared, and I should have continued to disseminate science of new carbon compounds. I bring here Lord Kelvin's example, who, in his last jubilee, spoke of the utility he had found by the continued conferences with his pupils."

Some Antipathies of Animals.—A number of very curious featuries in the antipathies of animals are pointed out in an article on the subject in the London Spectator. There are permanent hereditary antipathies, like those of cats against dogs, and purely instinctive, inexplicable antipathies, which are naturally the least common, but of which there are marked and definite examples. Of such is the disgust which the camel excites in horses. These animals "have been associated for centuries in the common service of man, and early training makes the horse acquiesce in the proximity of the creature which disgusts him. Otherwise, it is far more difficult to accustom horses to work with camels than with elephants, precisely because the repugnance is a natural antipathy and not a reasoned fear." They get used to the sight of an elephant, but the smell of a camel disgusts and frightens them. English horses that have never seen a camel

refuse to approach ground where they have stood. For this reason a traveling menagerie was recently refused permission to encamp on a village green, although the people would have been glad to see the show, but because the presence of the camels would interfere with the customary use of the place for a market, by engendering difficulties when the next attempt should be made to drive horses upon it. Yet, at a performance of two bears in London, one of the horses of a four-in-hand almost touched one of them, without himself or any of the team showing any nervousness over the matter. The hatred of cattle for dogs is supposed to have been inherited from the days when their calves were constantly killed by wolves or wild dogs. But "why the horse not only does not share this antipathy, but, on the contrary, loves a dog, it is difficult to explain." The dislike of the cat family for dogs likewise probably dates from the time when the wild dogs hunted and destroyed their whelps. "There is much probability in this conjecture, for it is the dog, and not the wolf, which the tiger so intensely dislikes, and it is only the packs of wild dogs, not wolves, which would venture to kill a cub. Leopards, which naturally live in branches of trees, simply look on dogs as a favorite article of food; and the puma of the pampas, which inhabits a country where the wild dog is unknown, is also a great dog-killer. The dogs, on their part, seem quite aware of the difference of view on the part of the various cats; they will mob a tiger and hunt all tiger-cats. But they all seem to fear the leopard, and by nature to fear the puma, though in North America they can be trained to hunt it. It was recently noticed that a large dog, which found its way to a point opposite the outdoor cages of the lion-house at the Zoo, crept underneath a seat as soon as the puma caught sight of it, and exhibited signs of the utmost nervousness and fear." The antipathies of most animals find a climax "in the common and intense horror of the poisonous snake."

MINOR PARAGRAPHS.

THE Municipal Administration Committee of the Reform Club of the City of New York has secured Mr. Robert C. Brooks as its secretary, who has established his office at the University Settlement House, 26 Delancey Street; has begun the collection of a working library, which is rapidly growing; and has practically completed a bibliography of Municipal Administration, of twenty-five hundred manuscript pages, comprising a subject index and another list, arranged alphabetically and containing nine thousand entries referring to thirty-four hundred articles in American, English, French, German, Italian, and Spanish publications, with the names of twelve hundred writers. It has more recently begun the issue of a quarterly magazine called Municipal Affairs, the first number of which contains the bibliography. It is working earnestly to enlist those who are willing to aid in propaganda work—chiefly by holding meetings, at which questions of municipal polity are discussed by competent speakers.

THE importance is insisted upon by Thomas A. Williams, in a paper on the Grasses and Forage Plants of the Dakotas, of making every effort to preserve the native grasses. They are naturally adapted to the conditions that prevail in the region, and it is very improbable that introduced forms can be had to take their places satisfactorily for many years to come. Climatal evidences are abundant to prove that some of the native forms will flourish under conditions that would kill the common cultivated ones; and the prolonged dry weather of the later summer, which would be destructive to cultivated species, simply cures these native ones on the ground, so that cattle can forage on them in winter as if they were hay. The importance of these grasses is illustrated by the immense shipments from the Dakotas of stock which have had no other feed than that growing naturally on the prairies. Many of the most valuable of these grasses are much benefited by judicious irrigation, even though it be only slight.

AN expedition is fitting out by the American Museum of Natural History, with the aid of Mr. Morris K. Jesup, for the systematic study of the peoples inhabiting the coasts of the North Pacific Ocean between the Amoor River in Asia and the Columbia River in America. The exploration is to be

prosecuted during six years, and to include both the Asiatic and the American coasts. Its primary object is to search for light concerning the origin of the American race and its relations to the races of the Old World, concerning which, in the absence of all definite knowledge at present, a confusion of opinions exists. The characteristics of the American races have been studied to a considerable extent by the Russian missionary Vemiaminoff, Dall, and others, in Alaska and the Aleutian Islands; Murdoch among the Eskimos of Point Barrow, and Boas under the auspices of the British Association in British Columbia; but, as Dr. Boas observes, very much remains to be done in those districts; while of the corresponding region in Asia, notwithstanding the few investigations that have been published, the types of man, languages, customs, and mythology are practically unknown.

Among the interesting jubilees celebrated during 1896 was that of the York Retreat in England. In 1792 William Tuke, a member of the Society of Friends, became convinced that the methods of treatment of the insane which prevailed at that time were unnecessarily harsh; they were treated more like wild beasts than as human beings. William Tuke therefore conceived the idea of founding an institution where sufferers from mental disease could be treated in a manner more in accordance with humanity and with sound therapeutic principles. The necessary support was after a time obtained, and the "Retreat" was opened in 1796. It was the first institution in England where the insane were treated in a humane and rational manner.

Mr. B. N. Brough affirms, in a lecture on deep mining, that the greatest depth yet reached in mines is 4,900 feet at the Red Jacket shaft of the Calumet and Hecla mine, in the Lake Superior district. The Tamarack mine, in the same district, 4,450 feet, is the only other mine going below 4,000 feet in depth. Four mines in Germany, two in Belgium, and one in Austria-Hungary are between 3,500 and 4,000 feet deep. The deepest British mine is the Pendleton, near Manchester, 3,474 feet deep; and the deepest in Scotland is the Niddrie, at Porto Bello, 2,010 feet. The products of the mines are now lifted with ropes of crucible steel wire, of which a flat rope is mentioned weighing only 8·2 pounds per foot, which had a tensile strength of eighty-nine tons per square foot, and lasted twelve months while used for raising loads of eleven tons from a depth of 3,117 feet. At the deep mines of Calumet the cage, carrying six tons, was lifted at the rate of a mile in a minute and a half. In England the speed has been as great as fifty-seven miles an hour. The increased cost of sinking these deep mines is believed not to be very appreciable where the output is considerable. At Tamarack the cost of increasing depth was more than compensated by the increased output and improved machinery.

The most important events in last year's history of the astronomical observatory of Harvard College were the erection of the Bruce photographic telescope in Peru, and the establishment of a series of circulars, which furnish a prompt means of announcing discoveries. Twenty-five hundred and eight photographs were taken with the eight-inch Draper telescope, and twenty-seven hundred and seventy in Peru with the eight-inch Bache telescope; and "there is probably no star brighter than the thirteenth magnitude in any part of the sky from the north to the south pole that does not appear on one or more of these plates." The attempt is made to photograph all the regions in which variables are discovered at least once a month. In Mrs. Fleming's examinations of the spectra photographed, a large number of objects having peculiar spectra have been discovered. Two new stars have been found in the constellations Carina and Centaurus. The photographs of one of the new variable stars show a very peculiar spectrum and changes of light unlike those of any star hitherto discovered. Meteorological observations were continued at La Joya, 4,150 feet above the sea; Arequipa, 8,060 feet; Alto de los Huesos, 13,300 feet; Mont Blanc station on El Misti, 15,600 feet; El Misti, 19,200 feet; and Cuzco, 11,000 feet.

A work by M. Meguin on the Bacteria of Dead Bodies is reviewed in a recent issue of the British Medical Journal: "As a result of this work it is now possible to determine in a most accurate manner the time of death

of an individual by an examination of the cadaver and of the successive generations of insects which are found inhabiting it. The author has established the important fact that these successive inhabitants always arrive in the same order from the time of death to that of complete disintegration of the body. . . . The importance of this work from a medico-legal point of view can not be overestimated, and that it is capable of practical application the author shows by a number of interesting cases."

NOTES.

THE presidents of sections of the British Association, nominated for the coming meeting at Toronto, are: Section A, Mathematical and Physical Science, Prof. A. R. Forsyth, F. R. S.; B, Chemistry, Prof. W. Ramsay, F. R. S; C, Geology, Dr. G. M. Dawson, C. M. G. F. R. S.; D, Zoölogy, Prof. L. C. Miall, F. R. S.; E, Geography, Mr. J. Scott Keltie; F. Economic Science and Statistics, Prof. E. C. K. Gonner; G, Mechanical Science, Mr. G. F. Deacon; H, Anthropology, Prof. Sir W. Turner, F. R. S.; I, Physiology, Prof. M. Foster, Sec. R. S.; K, Botany, Prof. H. Marshall Ward, F. R. S. The evening discourses will be delivered by Prof. Roberts-Austen, C. B., F. R. S., and Prof. John Milne, F. R. S.

A BANQUET was recently given by scientific men of France to Mme. Clémence Royer in celebration of her seventieth birthday. She is eminent in the study of the mental traits of animals; translated Darwin's work into French; is an advocate of evolution; and is the author of articles on the Mental Faculties of Monkeys, and Animal Arithmetic, which were published in the Popular Science Monthly several years ago.

MR. HERBERT SPENCER was offered the honorary degree of Doctor of Science by the authorities of the University of Cambridge, but, adhering to his uniform practice, from which he says he can not depart, has declined it.

THE Emperor of Germany has just decorated Dr. Roux, the discoverer, with Dr. Behring, of the vaccine against diphtheria. Two years ago Pasteur refused a similar honor, for reasons of his own. Dr. Roux, although the intimate friend and successor of the great scientist, did not allow his loyalty toward his master to stand in the way of accepting this mark of recognition from the foreign potentate.

THE Paris Academy of Sciences has awarded an Arago medal to Lord Kelvin, on the occasion of the jubilee of his professorship in Glasgow University. In conferring it, M. Cornu, the president, touching on the testimonies coming from all parts of the world, said: "Nothing is more consoling for the future than the spectacle of these honors rendered by delegates of all nations to great men of science like Kelvin and Pasteur, who so worthily represent science in its loftiest and at the same time most beneficent aspect."

ACCORDING to the Times, the Government intends to introduce next session a bill to promote free vaccination throughout England, following continental methods. A small committee, headed by Dr. Thorne Thorne, of the Local Government Board, has investigated these methods in Paris at the Institut Vaccinal and the Académie de Médecine, and in Brussels at the École de Médecine, and at Dr. Janssen's vaccination department under the municipality of the city. They intend also to investigate the modes of procedure in Germany.

EDWARD D. COPE, Professor of Zoölogy and Comparative Anatomy in the School of Biology at the University of Pennsylvania, died in his museum in Philadelphia, April 12th, aged about fifty-seven years. The illness which took him away was one from which he had been a sufferer for many years. He delivered his last lecture at the university two weeks before his death, had been able to attend to some scientific work the Wednesday previous, and his condition had been alarming only for four days. A sketch of his life and work to that time, and a portrait, were given in the Popular Science Monthly for May, 1881. He was presiding officer of the Biological Section of the American Association in 1884, and was president of the Buffalo meeting of the association in 1896. His later publications since our sketch have been: Origin of Man and other Vertebrates, 1885; Tertiary Vertebrates, 1885; The Energy of Life Evolution, and how it has Acted, 1885; The Origin of the Fittest, 1886; and The Primary Factors of Organic Evolution, 1896. Prof. Cope was most eminent in paleontology, but was distinguished in many other branches of biology.

PROF. JAMES JOSEPH SYLVESTER, of the University of Oxford, died in London, March 15th, in the eighty-third year of his age. He was born in London, September 3, 1814, was graduated from St. John's College, Cambridge, in 1837, as second wrangler, was appointed Professor of Natural Philosophy in the University of London, and in 1841 became a professor in the University of Virginia. He did not, however, remain there quite a year, but returned to London, found employment as an actuary and conveyancer, and was called to the bar in 1850. He was appointed Professor of Mathematics in the Royal Military Academy at Woolwich, retired from this position in 1862, and was appointed Professor of Mathematics in Johns Hopkins

University. Here his abilities seemed for the first time to have free scope, and his career was brilliant. He established the American Journal of Mathematics, through which and by his personal teaching and influence he gave a great vitality to mathematical study in this country which still pervades it. In 1883 he was elected Savillian Professor of Mathematics in the University of Oxford, where he repeated the success he had achieved at Johns Hopkins and exerted as potent an influence.

PROF. HENRY DRUMMOND, who died in March, 1897, was best known to scientific and the religious circles by his book on Natural Law in the Spiritual World, which touched upon points in which both were interested. His later volume, a collection of Lowell Lectures, on the Ascent of Man, also went into both fields. These books, however, well intentioned and readable as they were, were subjected to adverse criticism from both sides. In 1879 he accompanied Sir Archibald Geikie in a geological tour in the Rocky Mountains, and afterward visited the Scotch mission stations in East South Africa. A result of this visit was a very interesting book on Tropical Africa.

MR. SIDNEY WALKER, fellow of the Royal Astronomical Society since 1873, whose death was recently announced, read several papers on nebulæ before the society, and contributed an article on the distribution of the stars in the southern hemisphere to the Monthly Notices for 1878. He made two very fine maps showing the distribution of the nebulæ and clusters in Dr. Dreyer's catalogue.

M. ANTOINE T. D'ABBADIE, a member of the French Academy of Science since 1857, in the Section of Geography and Navigation, died in Paris, after a long illness, March 20th, in his eighty-seventh year. His scientific work included exploration, astronomy, geodesy, physics, and numismatics. In 1893 he bequeathed to the Academy, reserving a life interest to his wife, the château of Abbadie, in the Pyrenees, which yields an annual revenue of 20,000 francs, and bank shares yielding 15,000 francs. He was one of the earlier explorers of Abyssinia, observed the eclipse of the sun of 1882 in Santo Domingo, and published important works on geographical exploration and geodesy.

PROF. CHARLES TOMLINSON, who died February 14th, in his eighty-ninth year, was on the Council of the British Association for the Advancement of Science, a fellow of the Royal Society, a fellow of the Chemical Society, and one of the founders of the Physical Society. For a number of years he was lecturer on Experimental Science at King's College, and was examiner in physics to the Birkbeck Institution. He held the Dante lectureship at University College, 1878–'80. He wrote many handy text-books on natural philosophy, meteorology, and natural history, and contributed largely to the Transactions of the Royal and Chemical Societies. In 1854 he edited Tomlinson's Cyclopædia of Useful Arts, Mechanical and Chemical, Manufactures, Mining, and Engineering. He compiled the lives of Smeeton, Cuvier, and Linnæus, and the notices of scientific men in The English Cyclopædia of Biography.

AMONG the men of science abroad who have died are Dr. Nikolai Zdekaner, St. Petersburg, member of the Imperial Academy of Sciences, and known for his work in behalf of hygiene and knowledge of epidemics; Herr Alois Rogenhofer, formerly Curator of the Imperial Natural History Museum in Vienna; Dr. Hermann von Noerdlinger, formerly Professor of Forestry in Tübingen University; Dr. Luigi Calori, Professor of Anatomy in the University of Bologna; Dr. J. D. E. Weyer, Professor of Mathematics and Astronomy in the University of Kiel; and M. Vivien de St. Martin, famous for his researches in ancient geography.

THE death is announced of Mr. Henry Boswell, a noted bryologist. Beginning his botanical studies with flowering plants, he later on turned his attention to the study of mosses, both British and foreign, and made a fine collection.

IT seems certain that eels, while not exactly amphibious, venture to spend considerable intervals of time on the land, away from water. A German zoölogist, Herr Frenzel, as well as several other persons, recently observed a young eel, about five inches long, concealed in the network of the superficial roots of a bush. It had come from a pond about fourteen feet away, and six feet lower down, and must have exerted vigorous efforts to climb the bank.

A CONSIGNMENT of the American crawfish (*Cambarus affinis*) has been received at the French agricultural station Fécamp, for acclimatation and propagation. These crustaceans are said to have been taken from the waters of the Potomac. They are sought because they appear not to be subject to the disease which has carried away most of the crawfish in the rivers of France, and are intended to make up for the loss occasioned thereby.

ONE of the latest papers of the late Sir Benjamin Ward Richardson set forth the qualities of organic membranes as insulators. Experiments were cited by the author going to show that various membranes of the animal body, in addition to performing the functions usually ascribed to them, are also electrical insulators, and by their presence confine and render useful the vital force that is developed in the organs they surround.